NATIONAL BUREAU OF STANDARDS REPORT

6190

Current-Intensity, Voltage-Intensity, and Current-Voltage of Airfield Lighting Lamps

By
Photometry and Colorimetry Section
Optics and Metrology Division



U. S. DEPARTMENT OF COMMERCE NATIONAL BUREAU OF STANDARDS

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Photometry and Colorimetry Section
Optics and Metrology Division

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Bureau of Aeronautics
Department of the Navy
and
Aeronautical Accessories Laboratory
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Department of the Air Force

IMPORTANT NOTICE

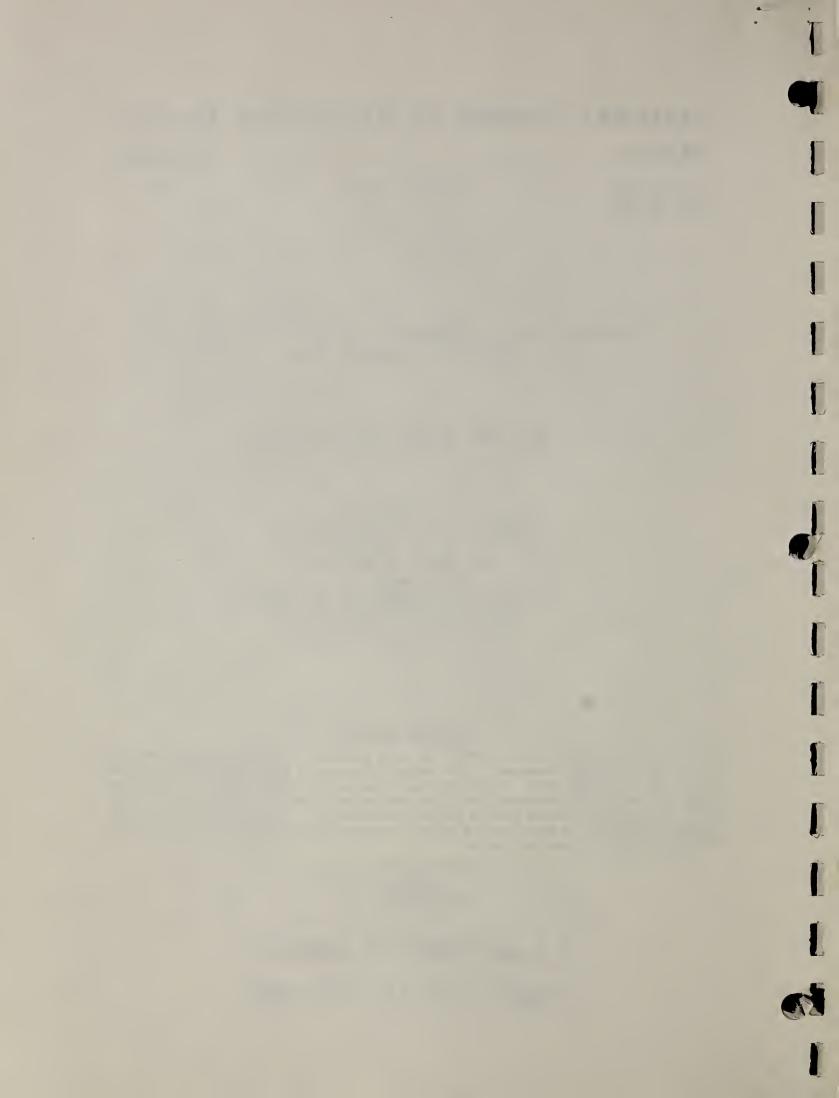
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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS



Current-Intensity, Voltage-Intensity, and Current-Voltage Characteristics of Airfield Lighting Lamps

SUMMARY

This report is an expansion of National Bureau of Standards Report 4463 and contains a compilation of measurements of the intensity-current-voltage characteristics of lamps of the types generally used in approach-, runway-, and taxiway-light systems. The results of a study of the effects of color filters on the relative intensity of the lamps are included. This report includes all data given in NBS Report 4463 in addition to the data obtained subsequent to the preparation of that report.

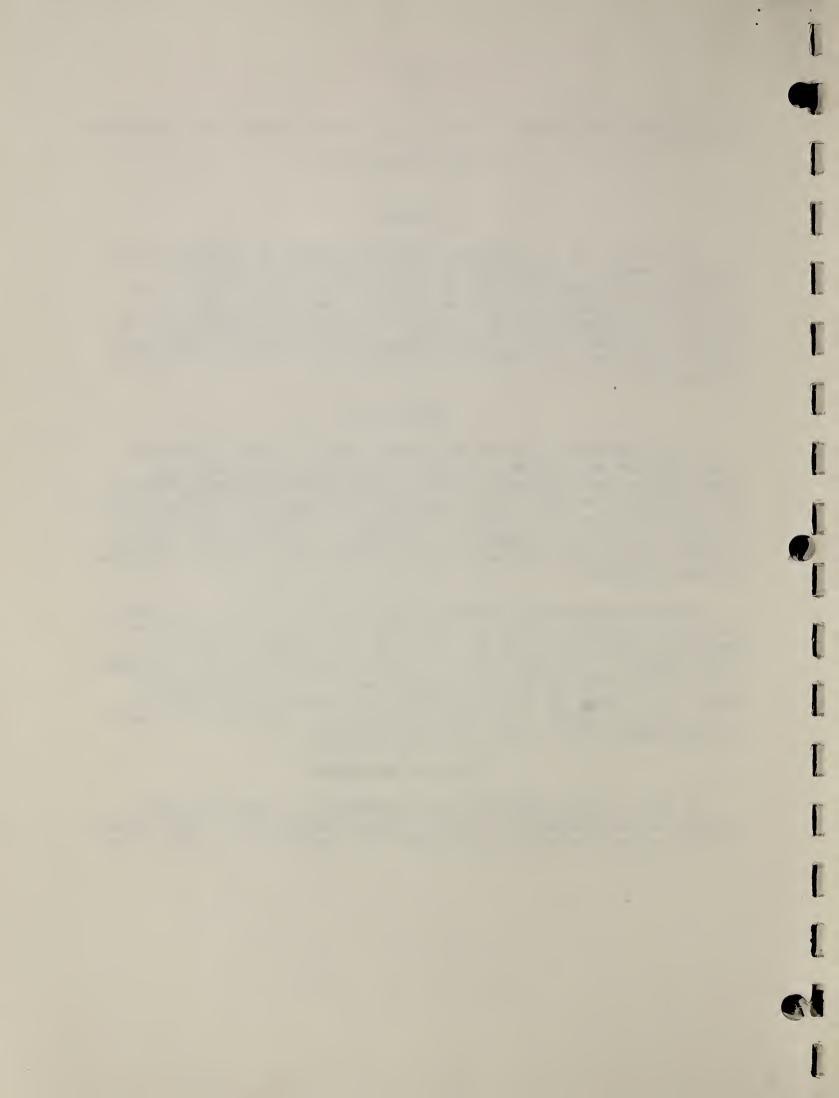
1. INTRODUCTION

Intensity control is now used on nearly all runway- and approachlight systems and on some taxiway-light systems. The increasing complexity of the problems of intensity control has increased the need for information on the relative intensity characteristics of lamps used in approach, runway, and taxiway lighting as a function of the applied current or voltage. In addition, information on the effect of color filters upon the relative intensity is needed. This report was prepared to meet this need.

Relative intensity is defined as the ratio, in percent, of the intensity of a lighting unit or lamp operated at a given current or voltage to the intensity of the same lighting unit or lamp operated at rated current or voltage. Note that in obtaining the relative intensity of a colored light, measurements of the intensity at both the given current or voltage and the rated current or voltage are made with the color filter in place. Thus, the transmittance of the filter has only a second-order effect on the relative intensity.

2. METHOD OF MEASUREMENT

A color-corrected barrier-layer photocell in a zero-resistance circuit was used in making relative intensity measurements. The response of this photometric system was checked. No significant deviations from



linearity were found. When reflector-type lamps were tested, the peak of the beam was directed at the photocell. The relative intensities of lamps other than the reflector type (325-lumen; 200-watt, T-14; etc.) were obtained by measuring the relative horizontal intensity in a given direction. Previous tests have shown that the relative intensity of the clear units in which these lamps are used does not differ significantly from the relative horizontal intensity of the lamps used. Voltage and current measurements were corrected for losses in the measuring circuits. Whenever possible several lamps of a given type were used, and the results of measurements of individual lamps were averaged.

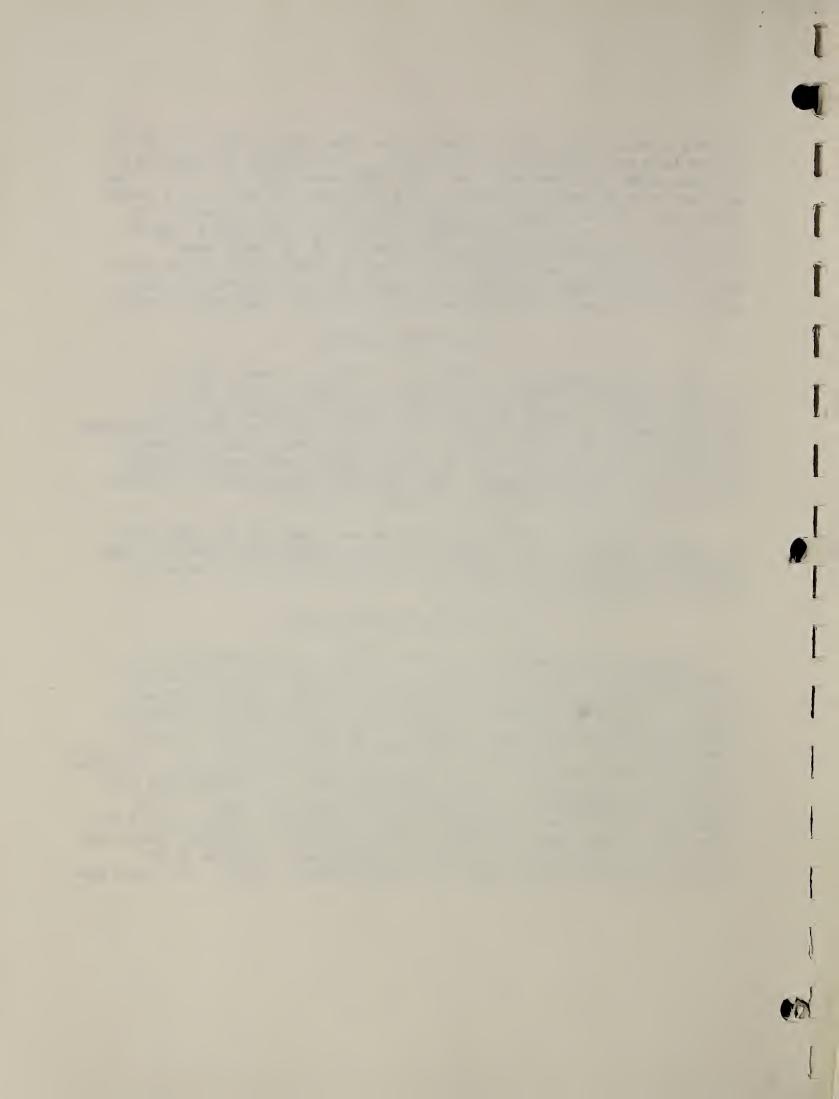
3. LAMP CHARACTERISTICS

The characteristics of each lamp are given as three curves: a, relative intensity-current; b, relative intensity-voltage; and c, voltage-current. Curves for lamps with similar characteristics have been grouped on the same figures. In addition, relative intensity-voltage characteristics of all 25- and 12.5-volt lamps, the relative intensity-current characteristics of all 20- and 10-ampere lamps and of all 6.6- ampere lamps have been grouped. The lamp types studied and the figures showing their characteristics are listed in table I.

Differences in relative intensity between lamps of the same type may become large when the relative intensity becomes less than 1%. The relative intensities may differ by as much as a factor of 2 when the relative intensity is about 0.2%.

4. EFFECTS OF COLOR FILTERS

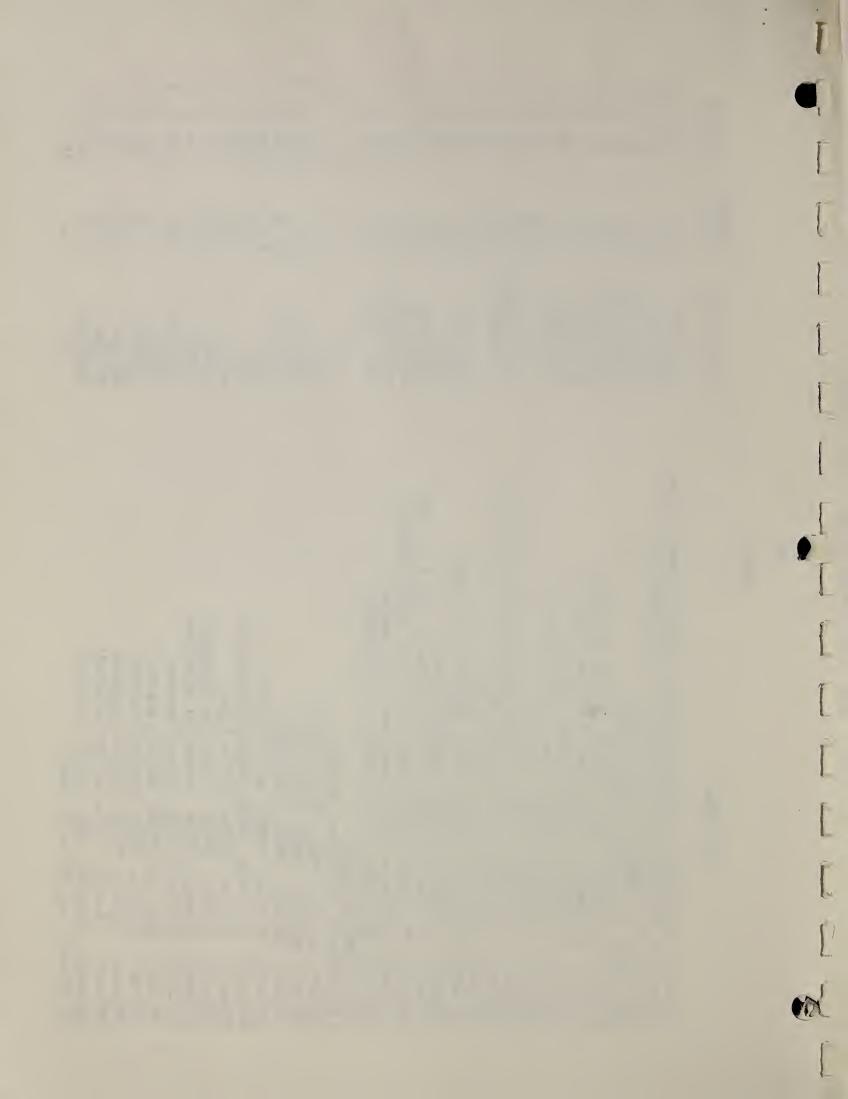
Because the transmittance of color filters is a function of the color temperature of the source, the relative intensity characteristics of colored lights will differ from those of similar lights which are "white." The determination and presentation of the relative intensity characteristics of each type of lamp for each aviation color would be unduly expensive. Therefore a study has been made to determine representative correction curves. Relative intensity characteristics were determined for several of the types of lamps listed in Table I in combination with filters representative of the limits of the aviation colors. It was found that the data were adequately represented by the lines plotted on figure 22. These lines show the relative intensity of lights meeting the specification requirements for aviation colors as a function of the relative intensity of the same light used without a filter. The lines are



Type

Lamp Type

7656 F/01 6298 X/01 325/6,6/A21 1020/6,6/A21 6,6/T10P 45PAR38/6,6 6,6/T14P	6.64/PAR56/2 6.64/T20P 204/PAR36 120PAR 204/T20/5 204/T20/5 204/T24/3	4588 75PAR/FL 75PAR/FL 4586 4519 200PAR 200PAR 200A/T10/P 250PAR 399PAR 399PAR 500T20/25
0 ° E 0 0 0	6.6-ampere, FAR56, 6.6-ampere, T-20, r 10-ampere, T-14, ai 20-ampere, PAR66, t 20-ampere, PAR66, s 20-ampere, PAR56, s 20-ampere, T-20, r 20-ampere, T-20, r 20-ampere, T-20, r ampere lamps	All 20-ampere and i0-ampere lamps 50-watt, 6-volt, PAR36, marine light 75-watt, 30-volt, PAR38, floodlight 75-watt, 75-volt, PAR38, floodlight 100-watt, 12.5-volt, PAR36, marine light 100-watt, 12.5-volt, PAR36, marine light 200-watt, 13-volt, PAR36, marine light 200-watt, 13-volt, PAR56, locomotive headlight 200-watt, 30-volt, PAR56, locomotive headlight 250-watt, 12.5-volt, PAR56, airport approach 350-watt, 25-volt, PAR56, airport approach 350-watt, 115-volt, PAR56, airport approach 350-watt, 115-volt, PAR56, airport approach 350-watt, 115-volt, PAR56, airport approach 350-watt, 125-volt, PAR56, airport approach 350-watt, 125-volt, PAR56, airport approach 350-watt, 125-volt, PAR56, airport approach



representative of "average" filters. The relative intensity of lights with filters near the specification limits may differ from that indicated by the lines by about ten percent at the lowest relative intensities shown. The difference will, of course, be less at higher relative intensities.

5. DISCUSSION

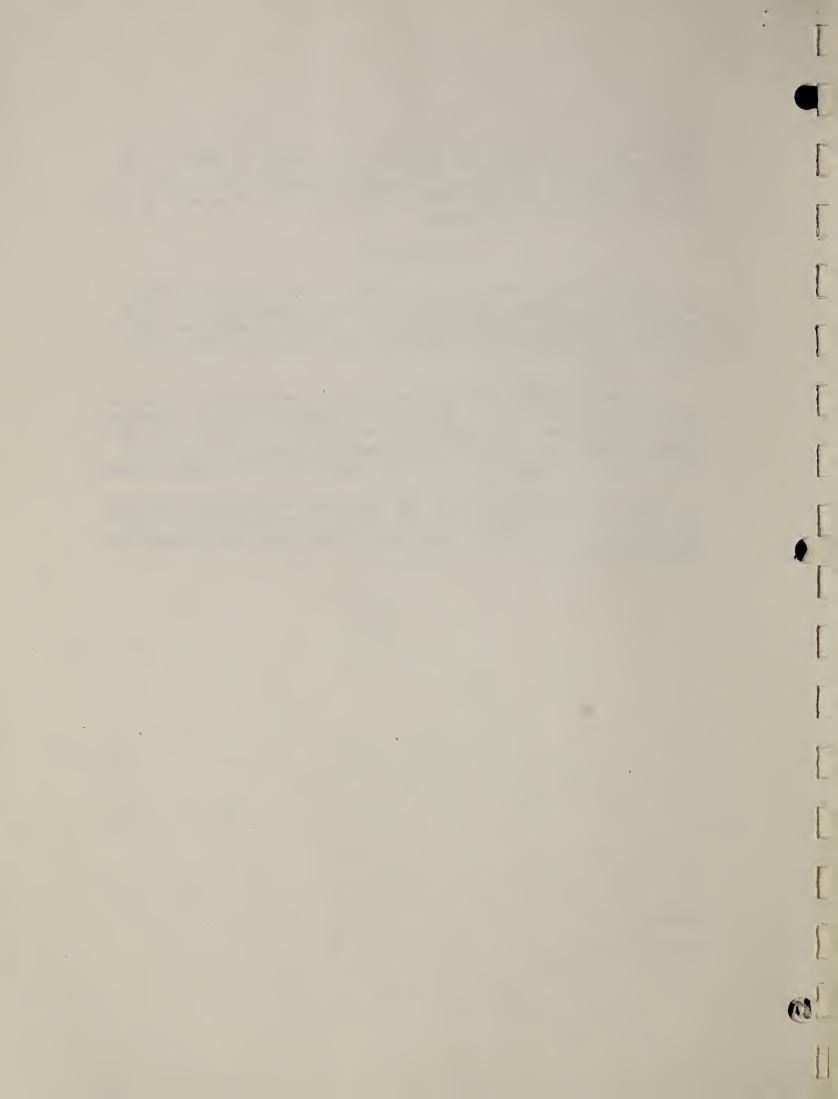
Differences in the change of relative intensity with change in current or voltage for different lamps are significantly large so that generalized lamp-characteristic exponents cannot be satisfactorily used for all lamp types when the relative intensity is varied over a wide range.

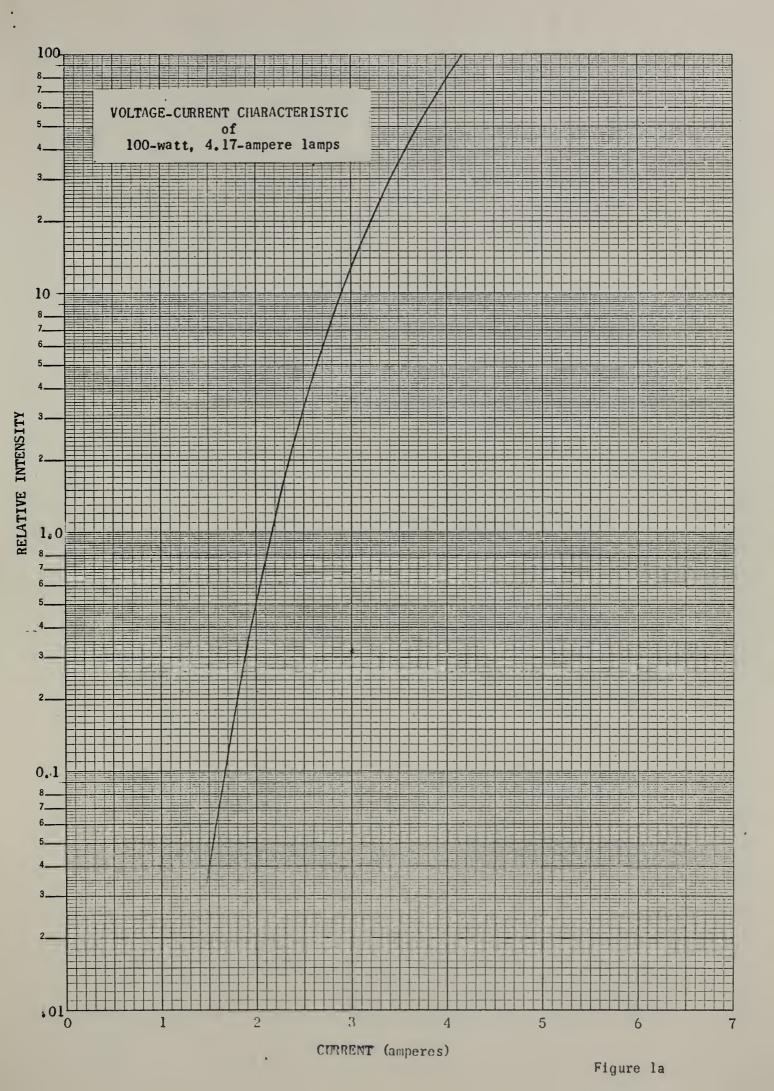
For series lamps with the same rated current and of similar design wattage (within 25%), the relative intensity-current characteristics are similar. See the curves on figures 11 and 12. The data shown on figure 21 indicate that relative intensity-voltage characteristics are similar for multiple lamps of similar design wattage.

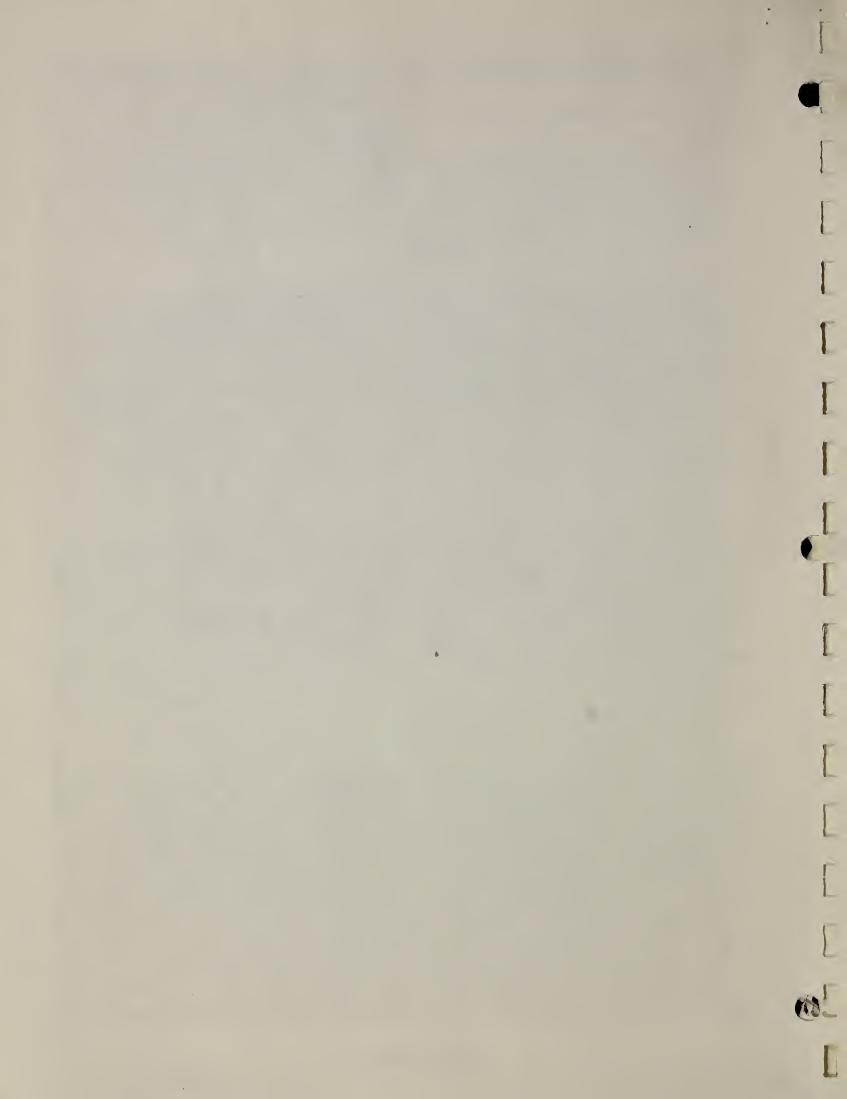
The data shown in figures 18a, 18b, and 18c indicate that the characteristics of reflector-type lamps are not significantly different from those of other lamp types of the same rated wattage and voltage or current.

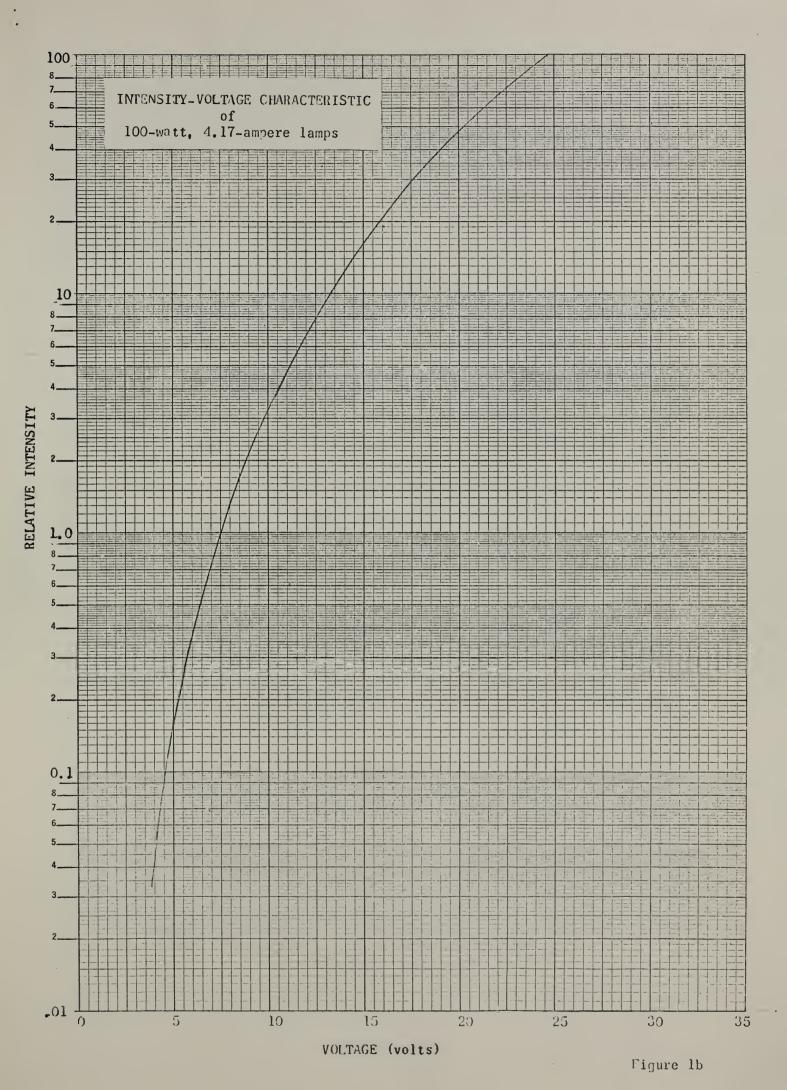
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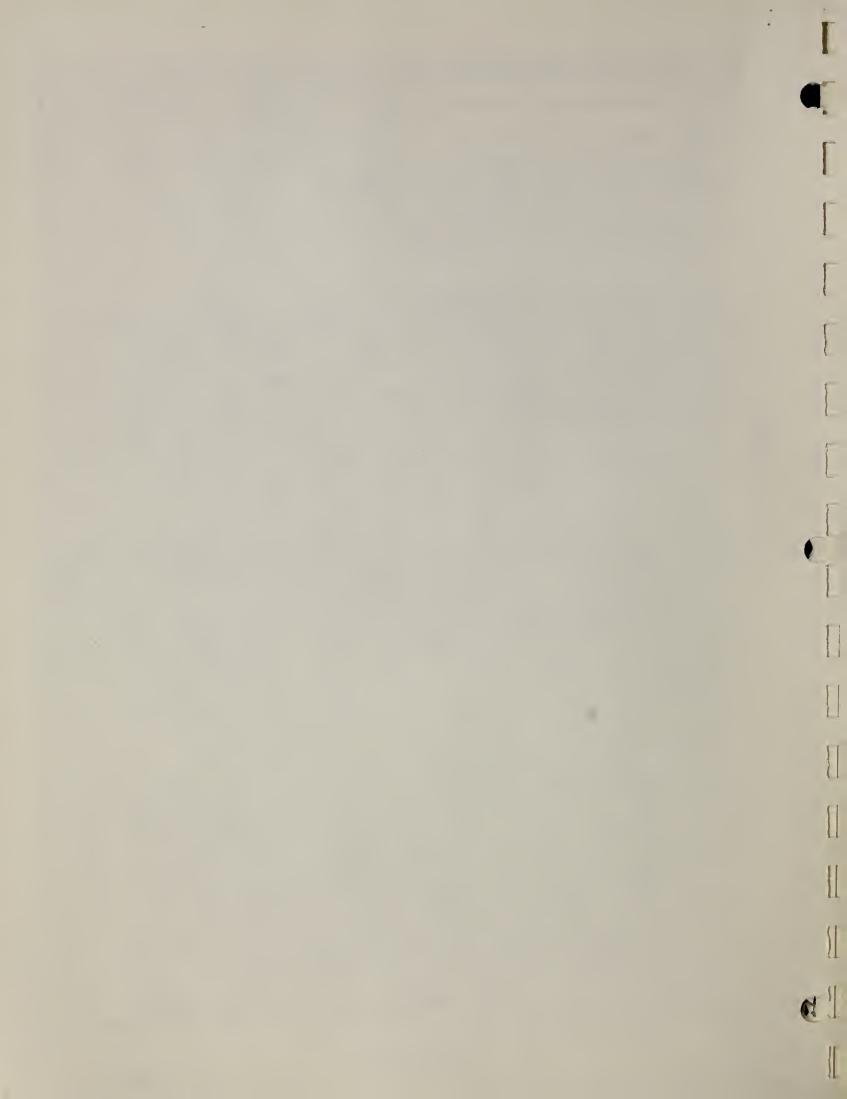
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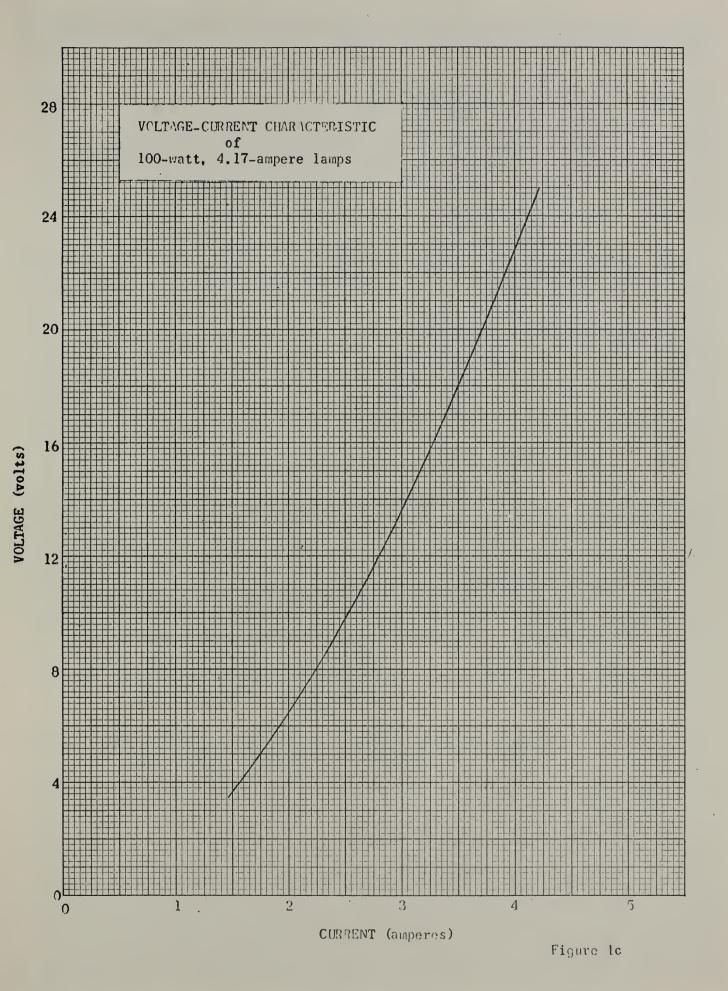




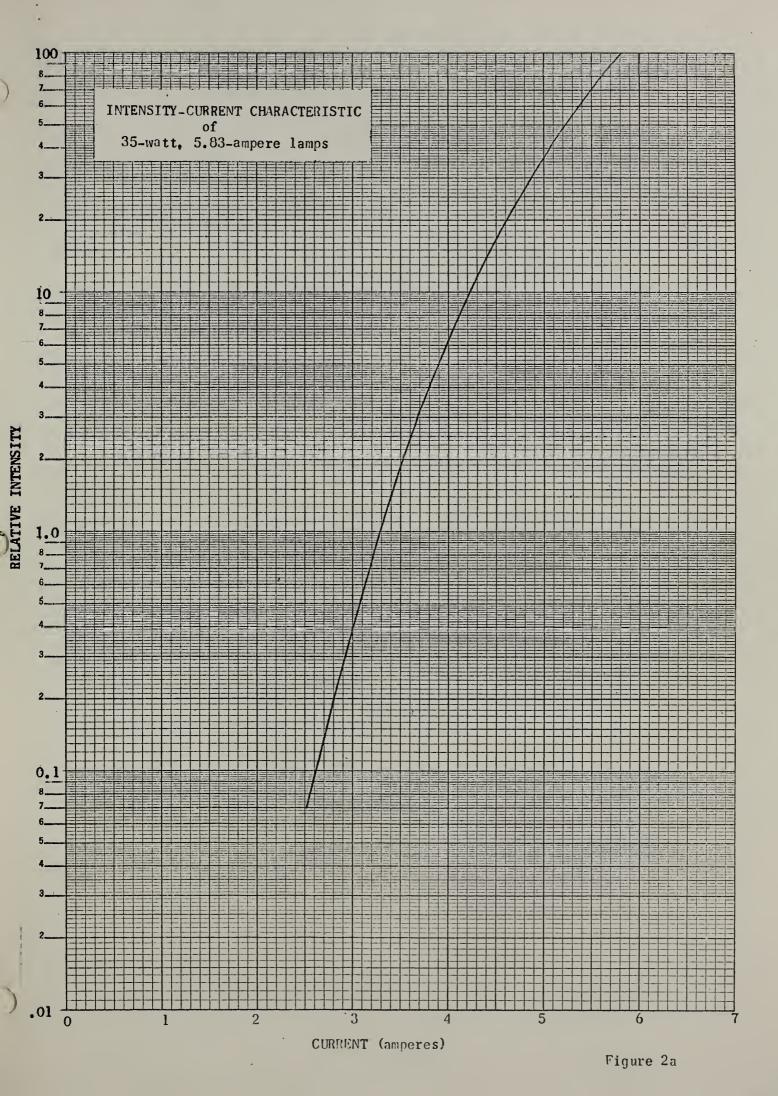


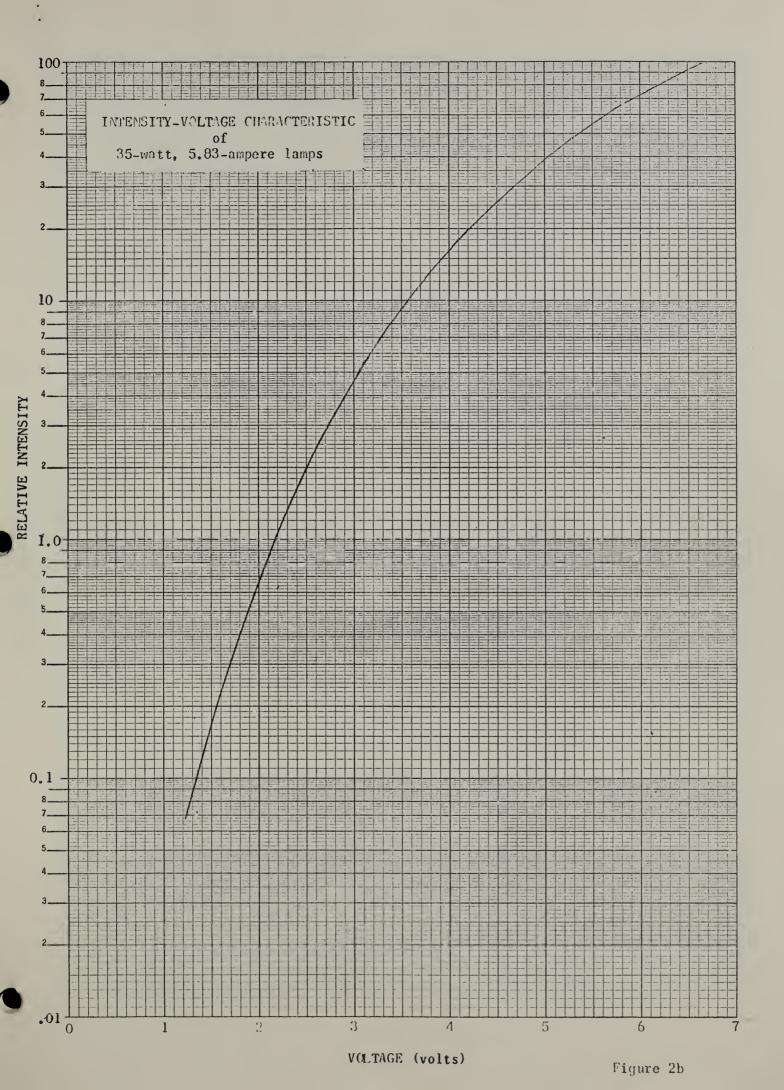


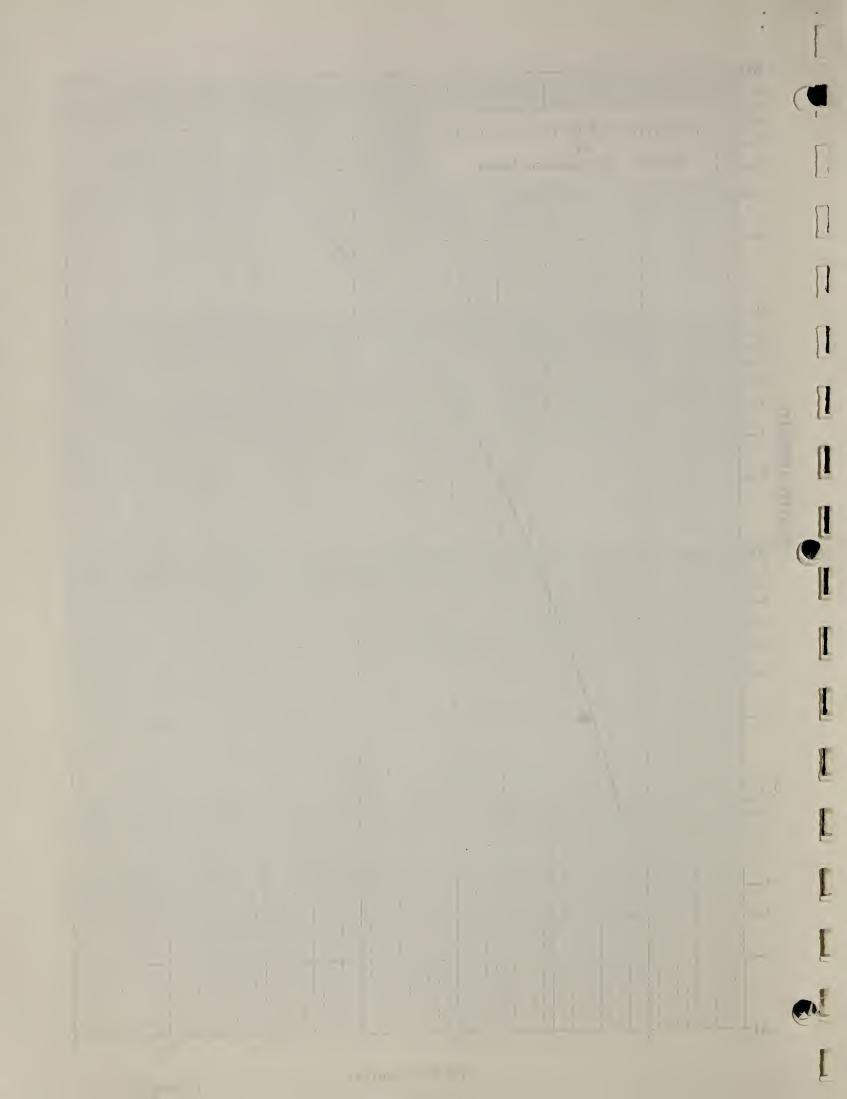


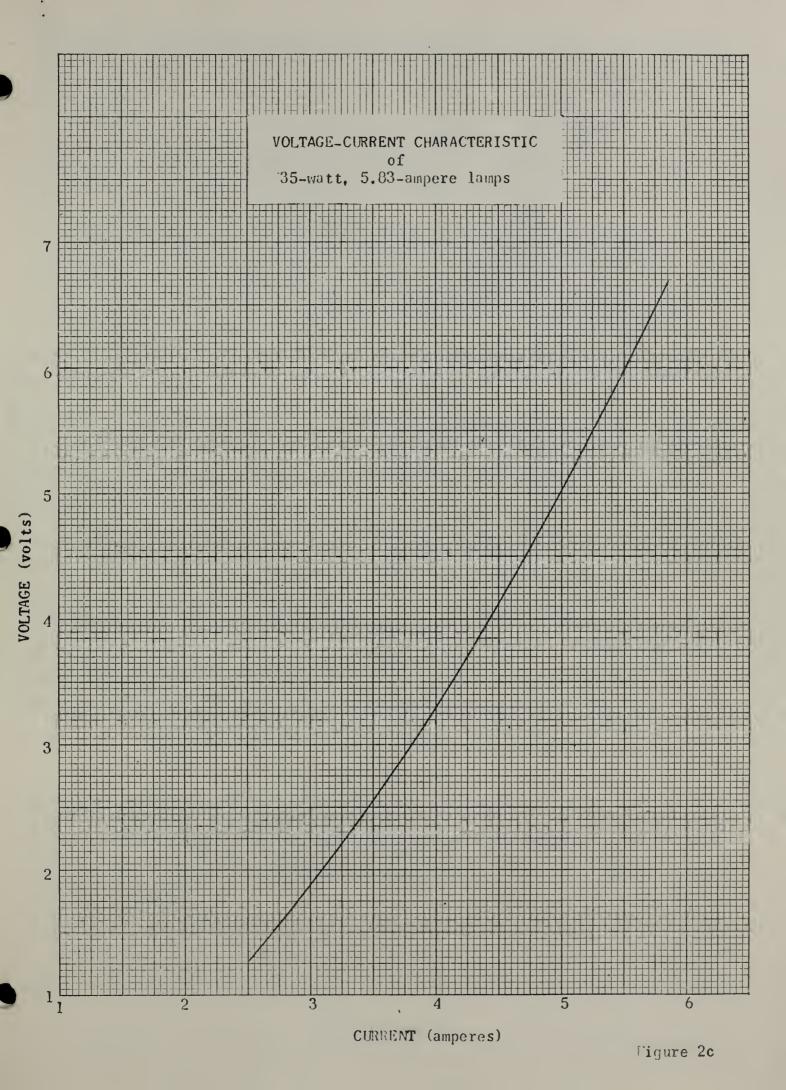


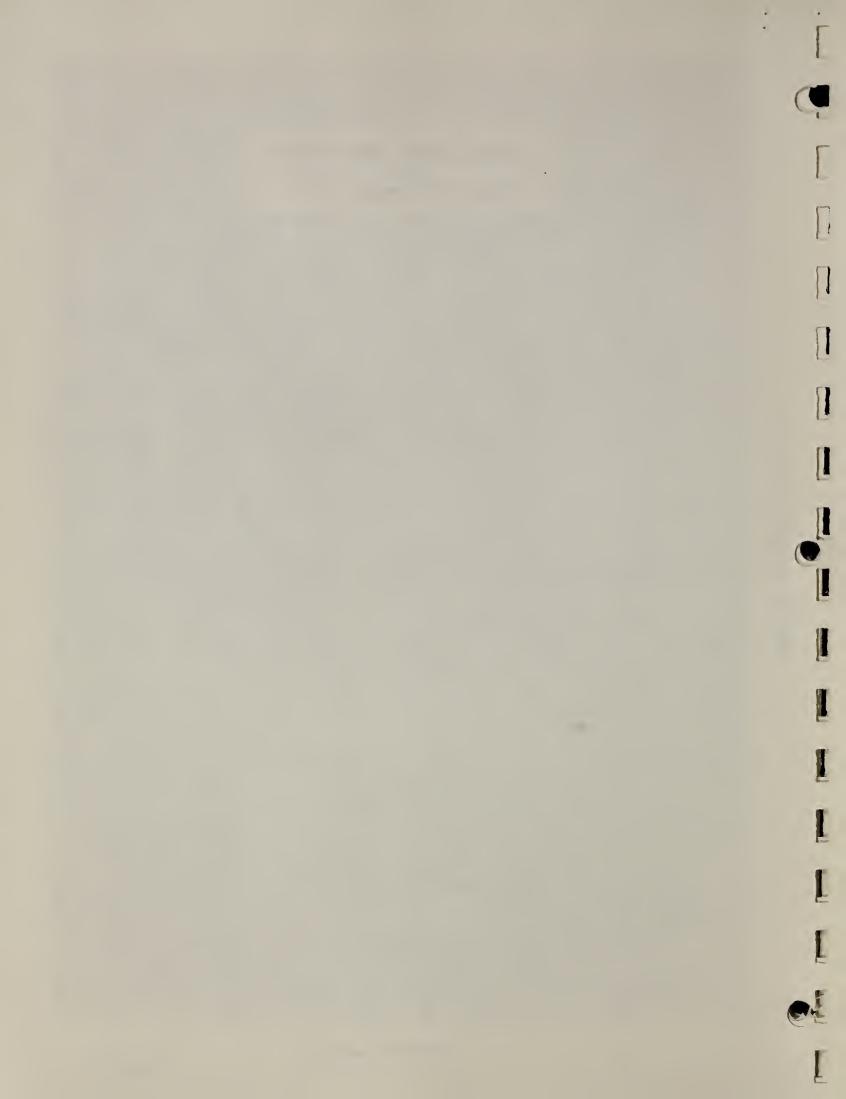
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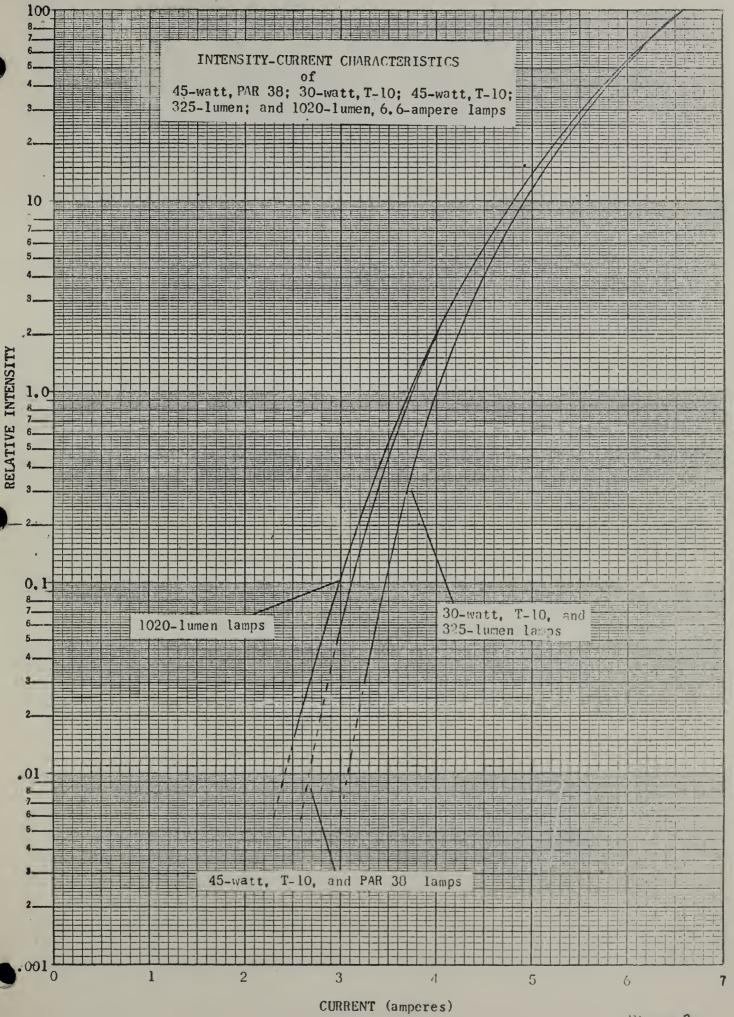


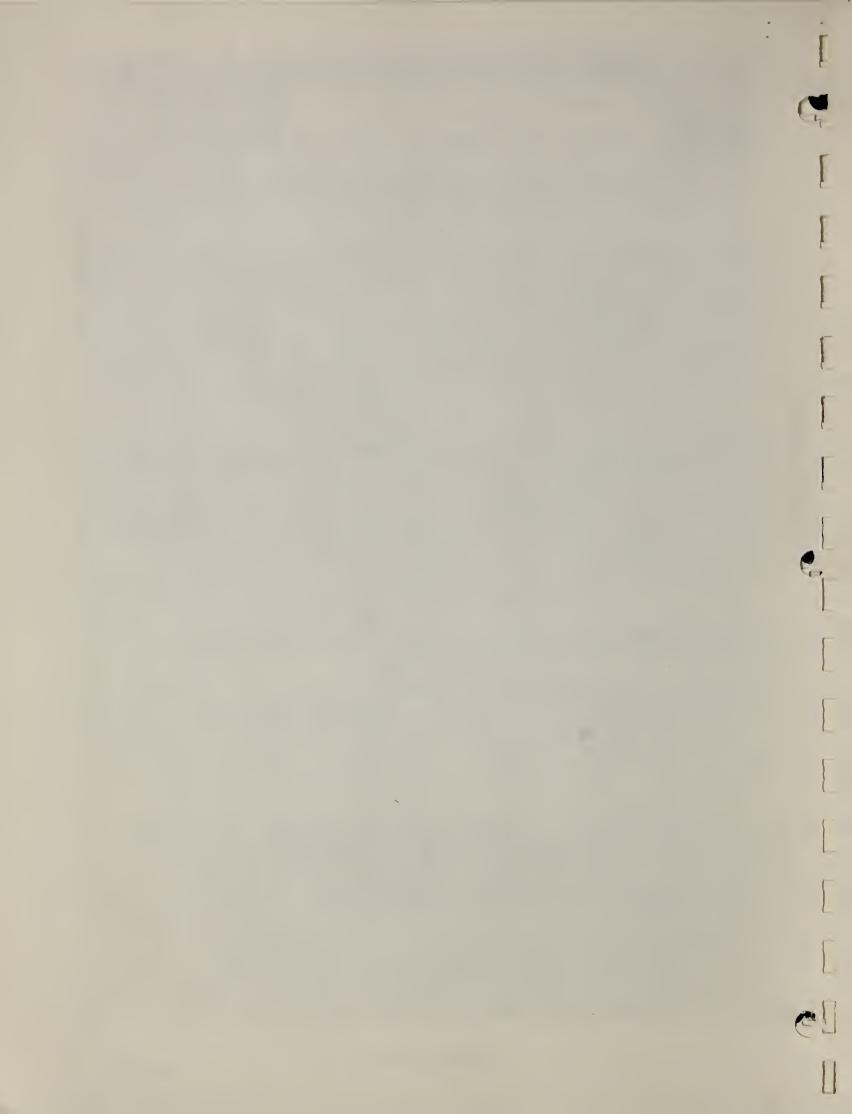


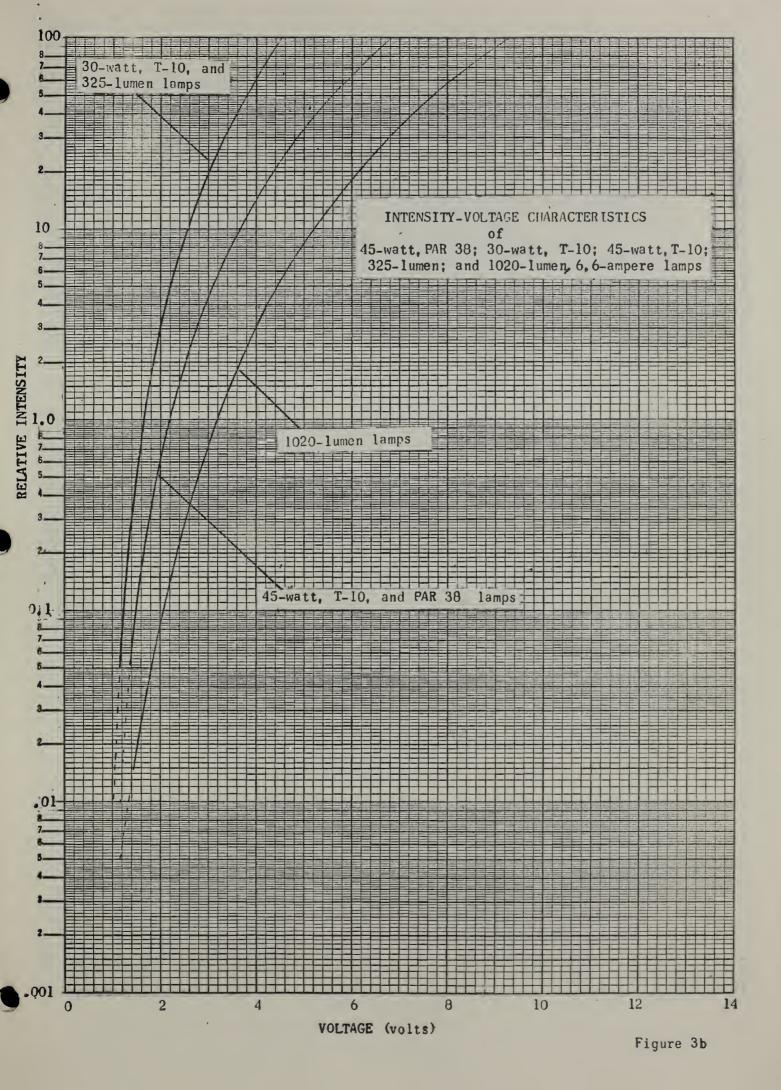


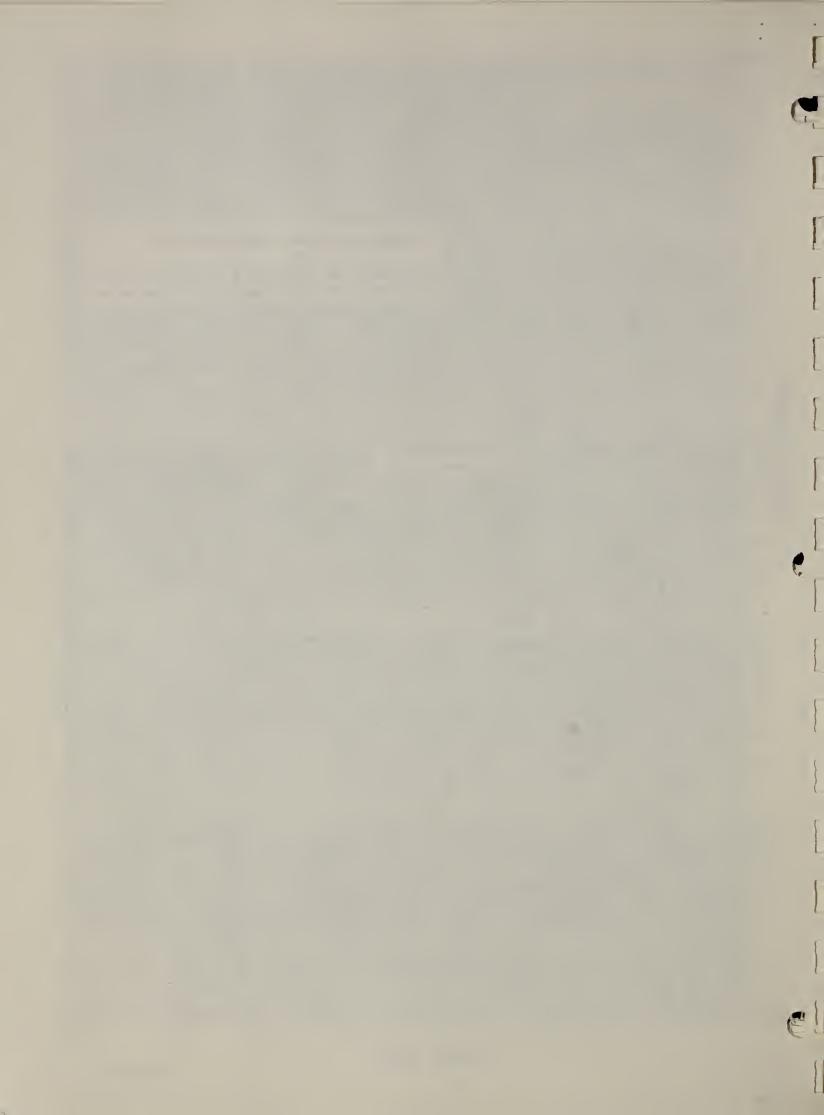


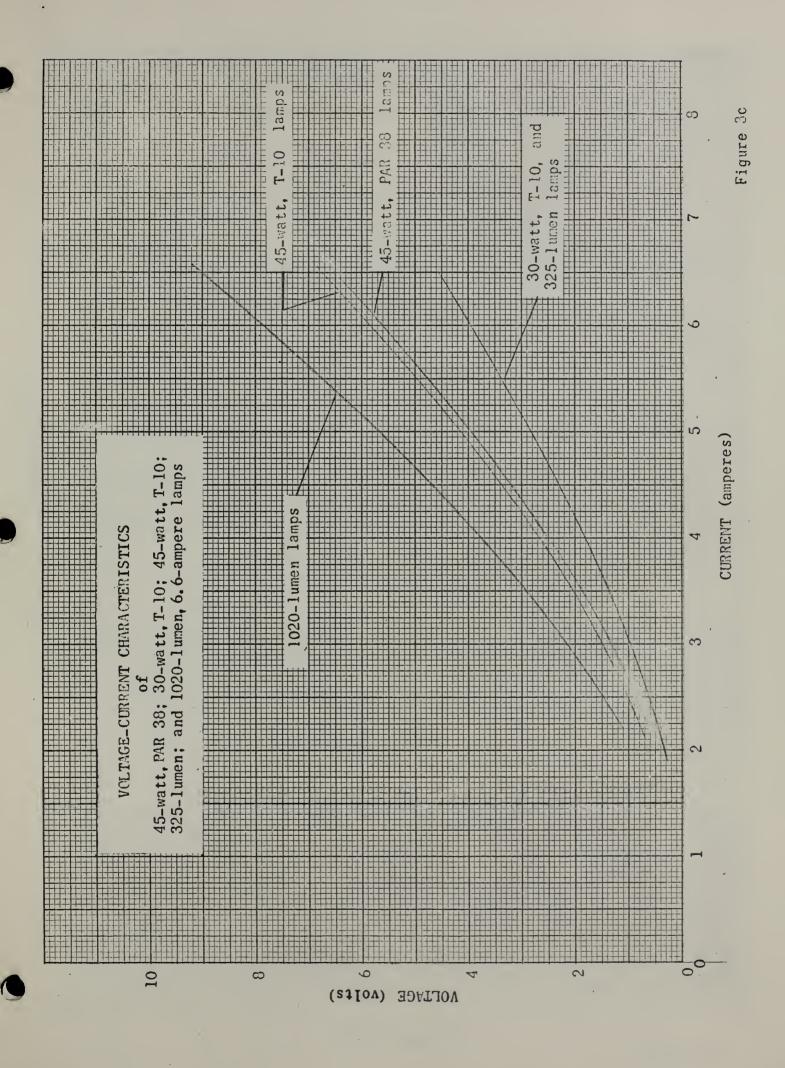


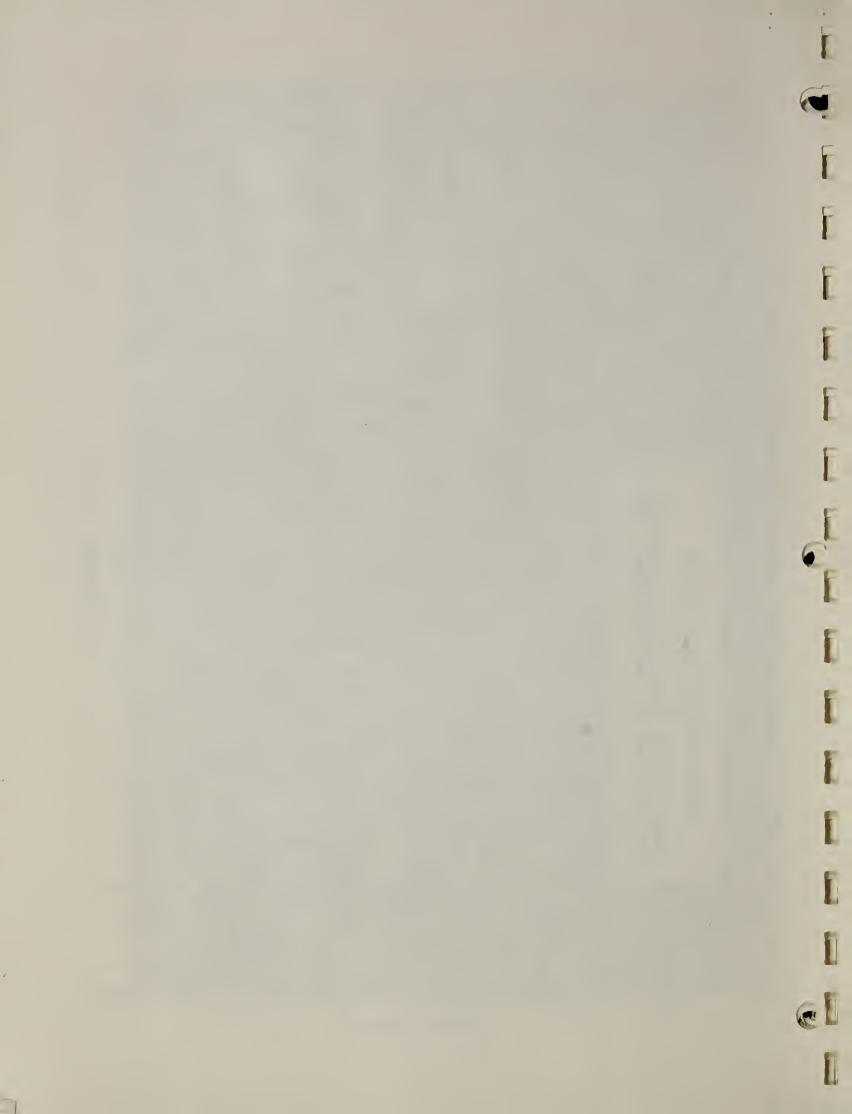


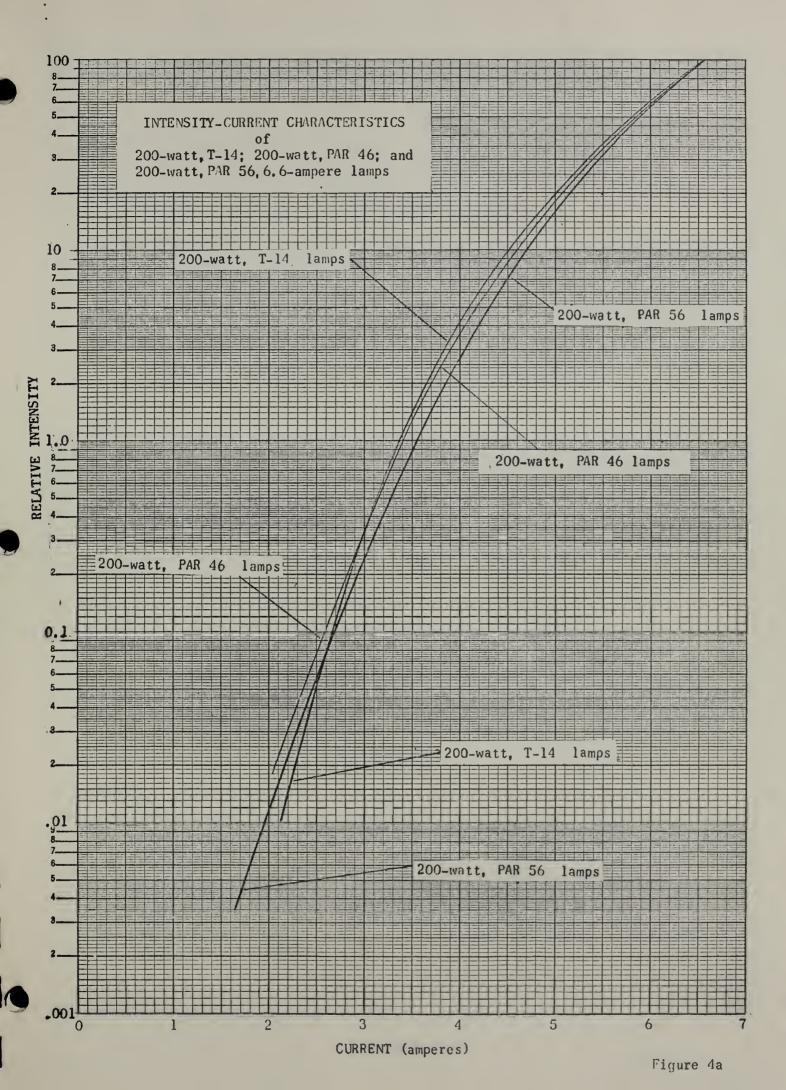


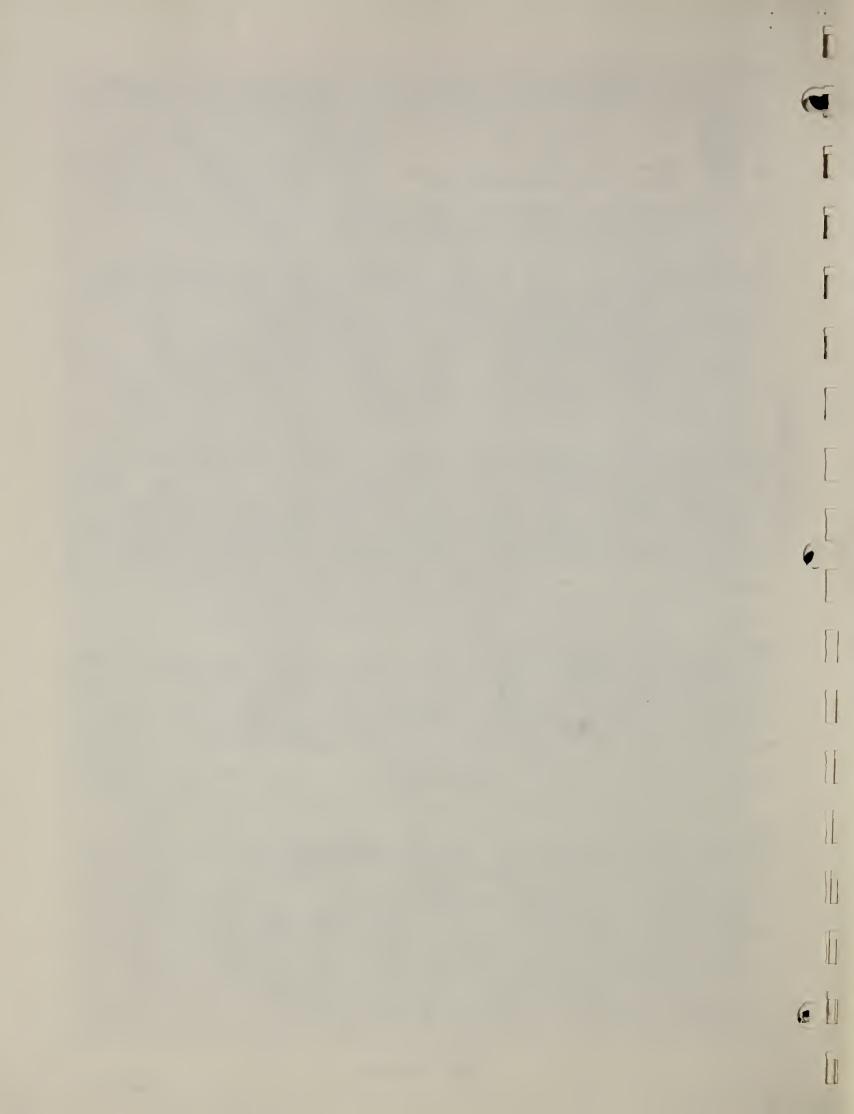


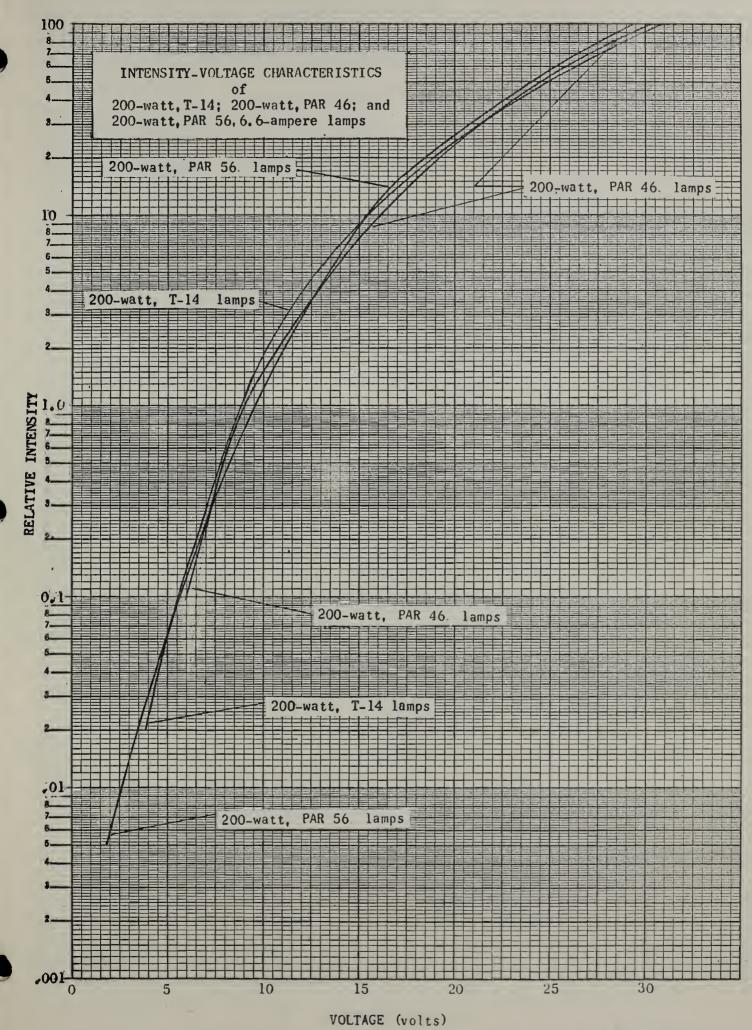


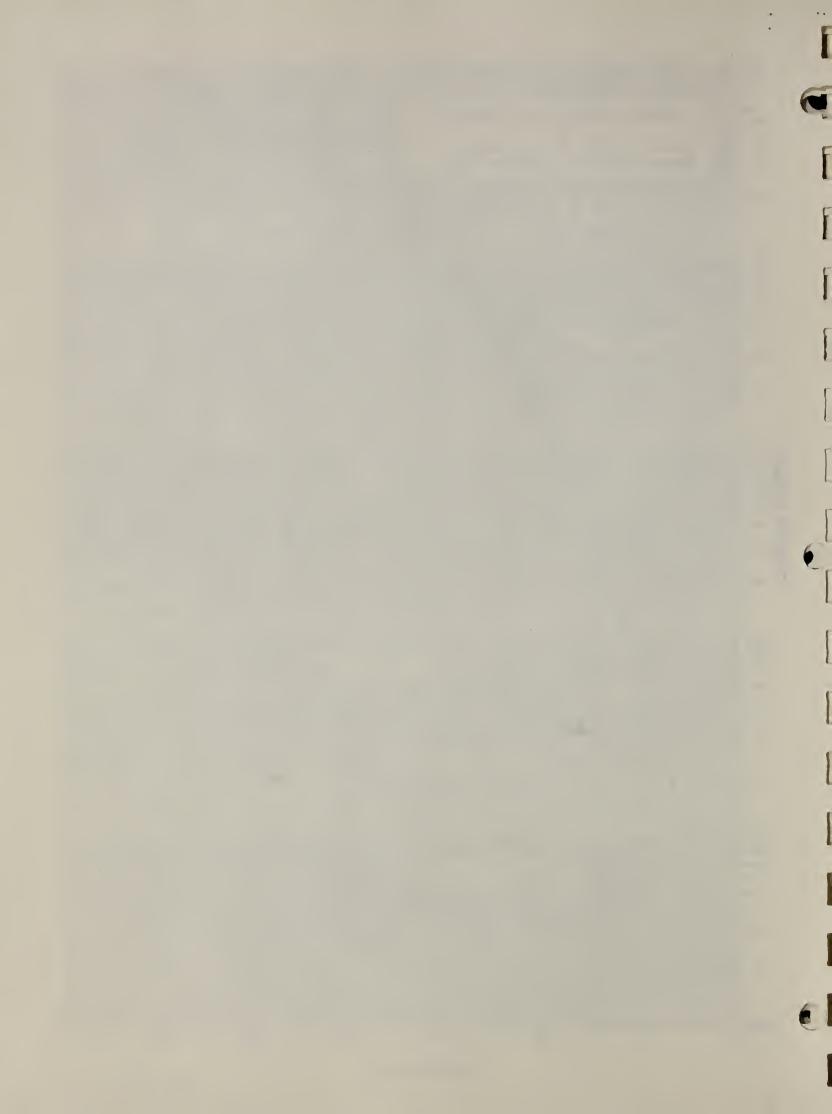


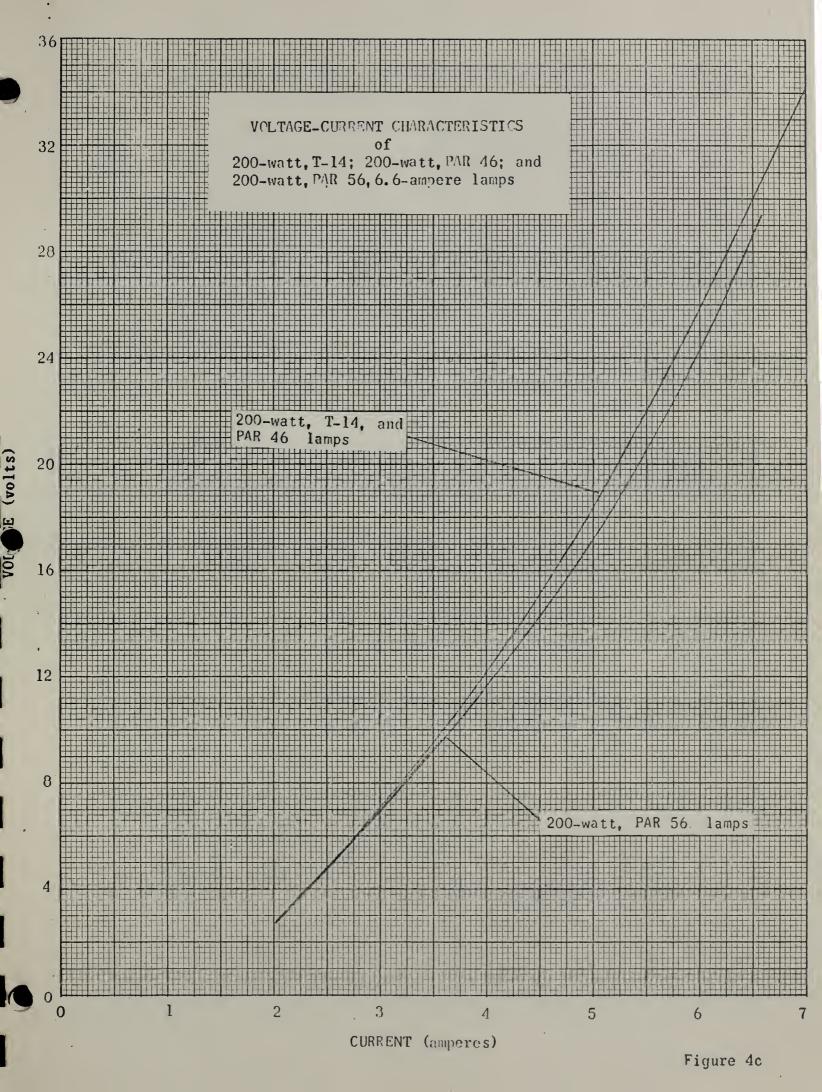


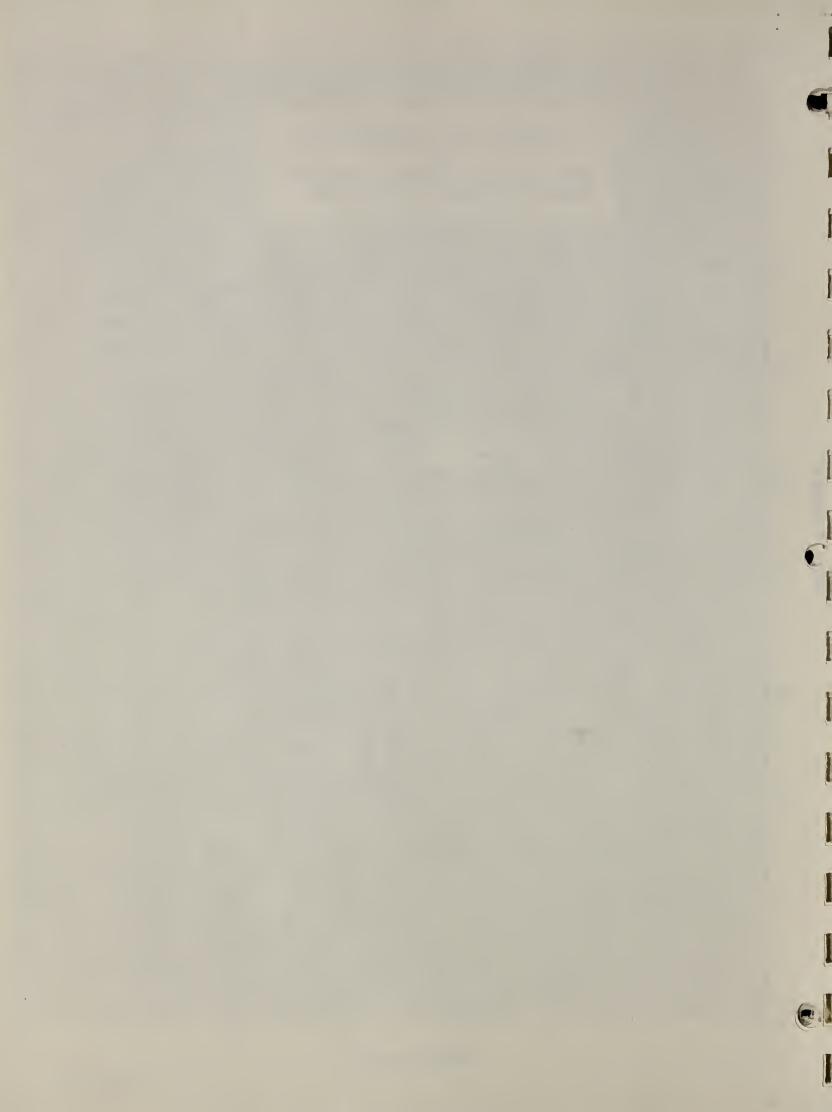


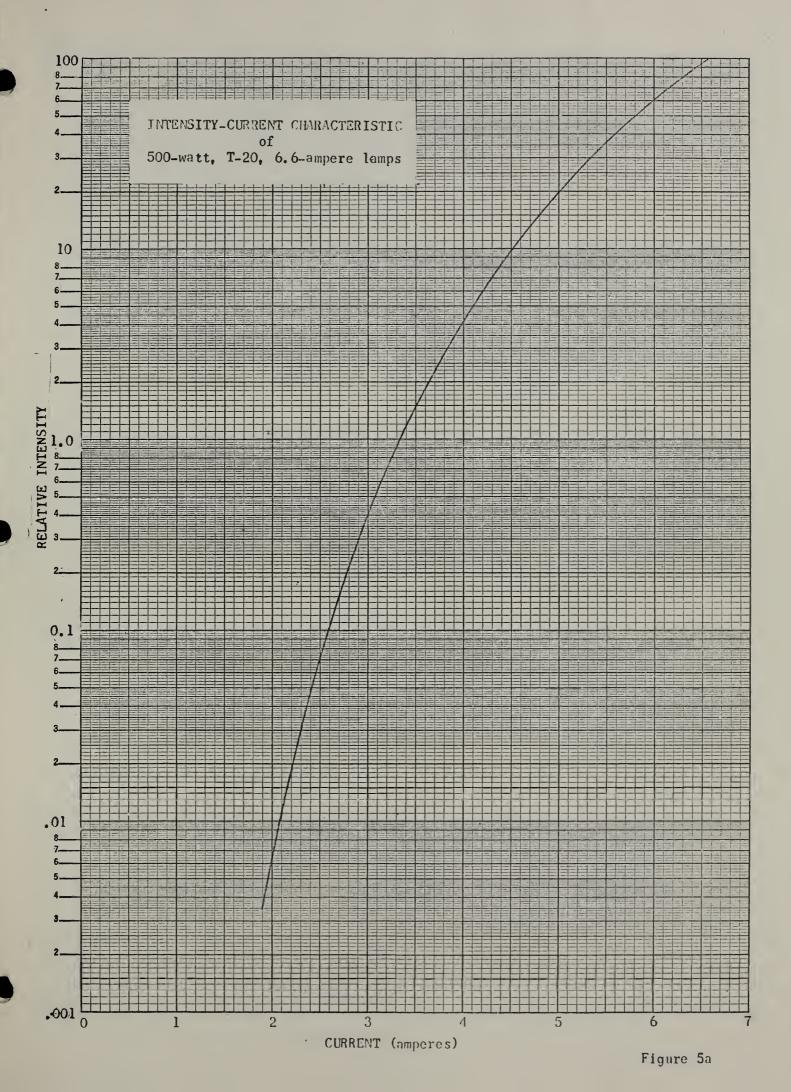


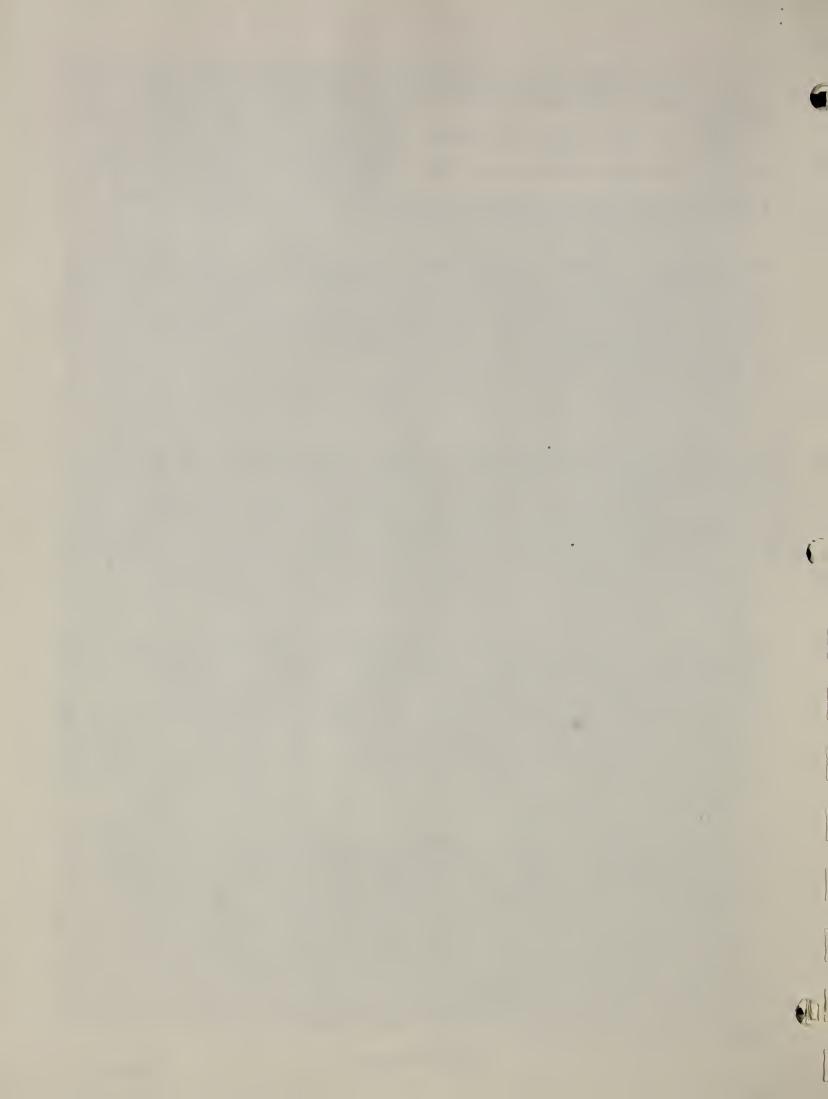


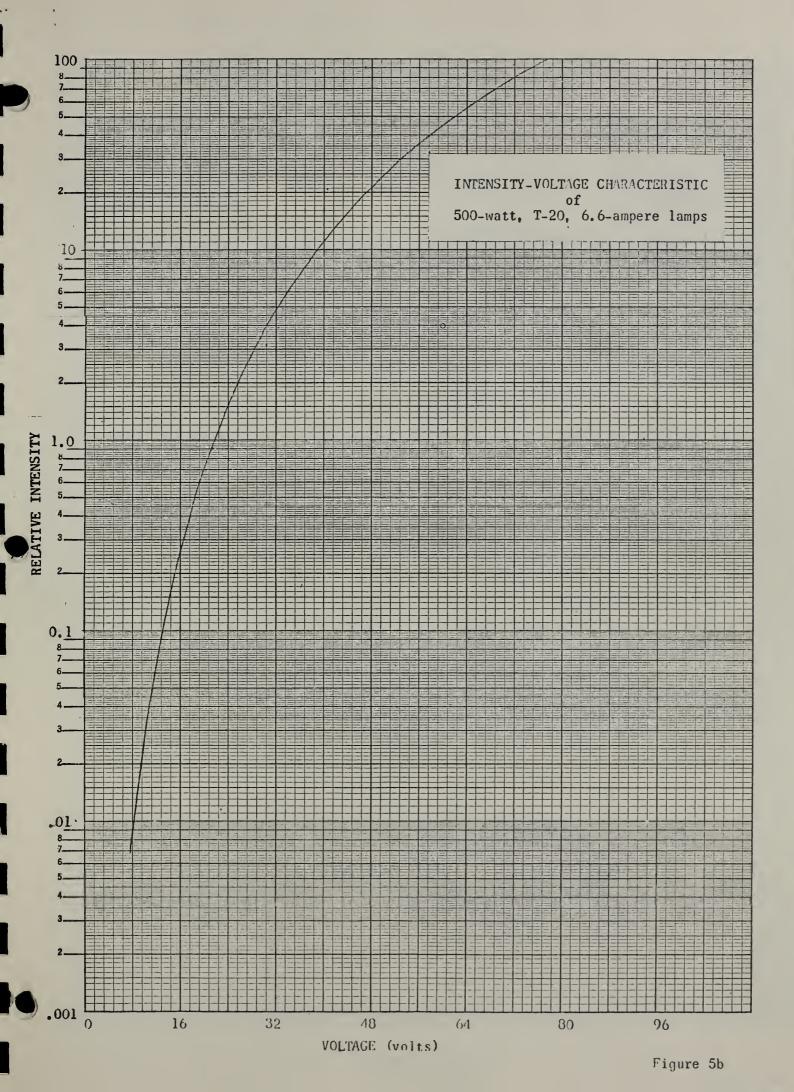


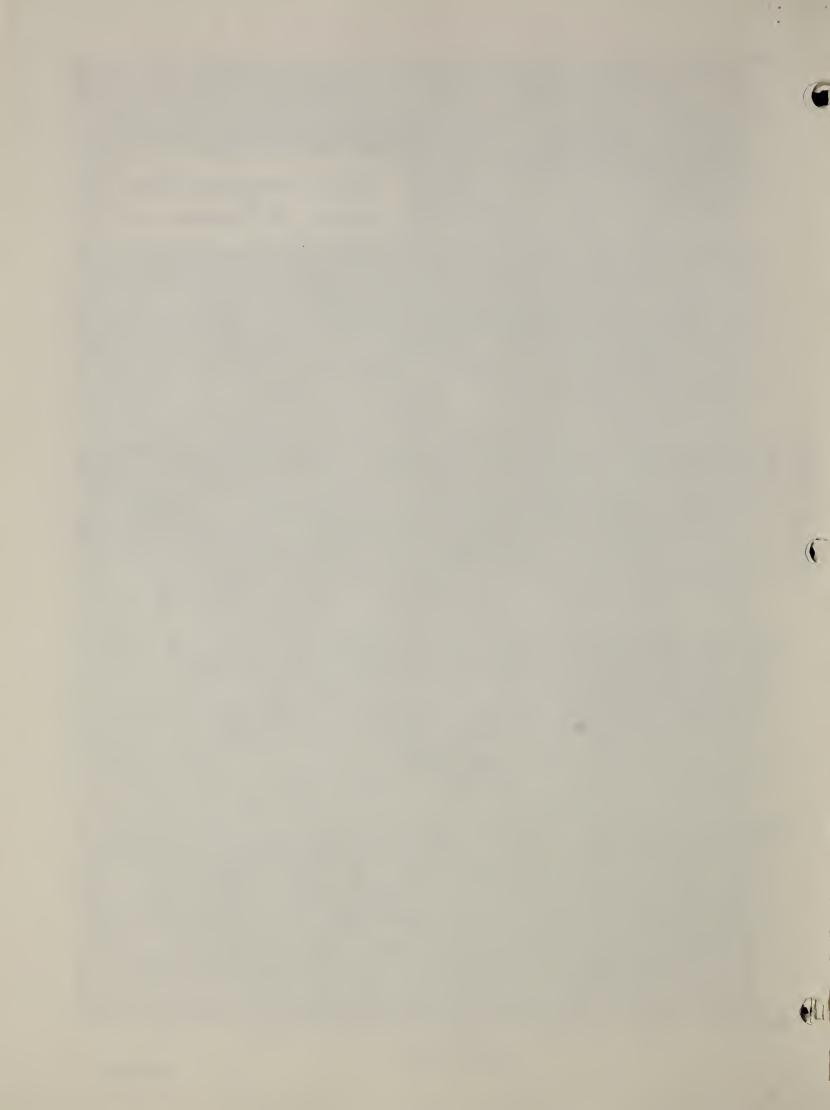


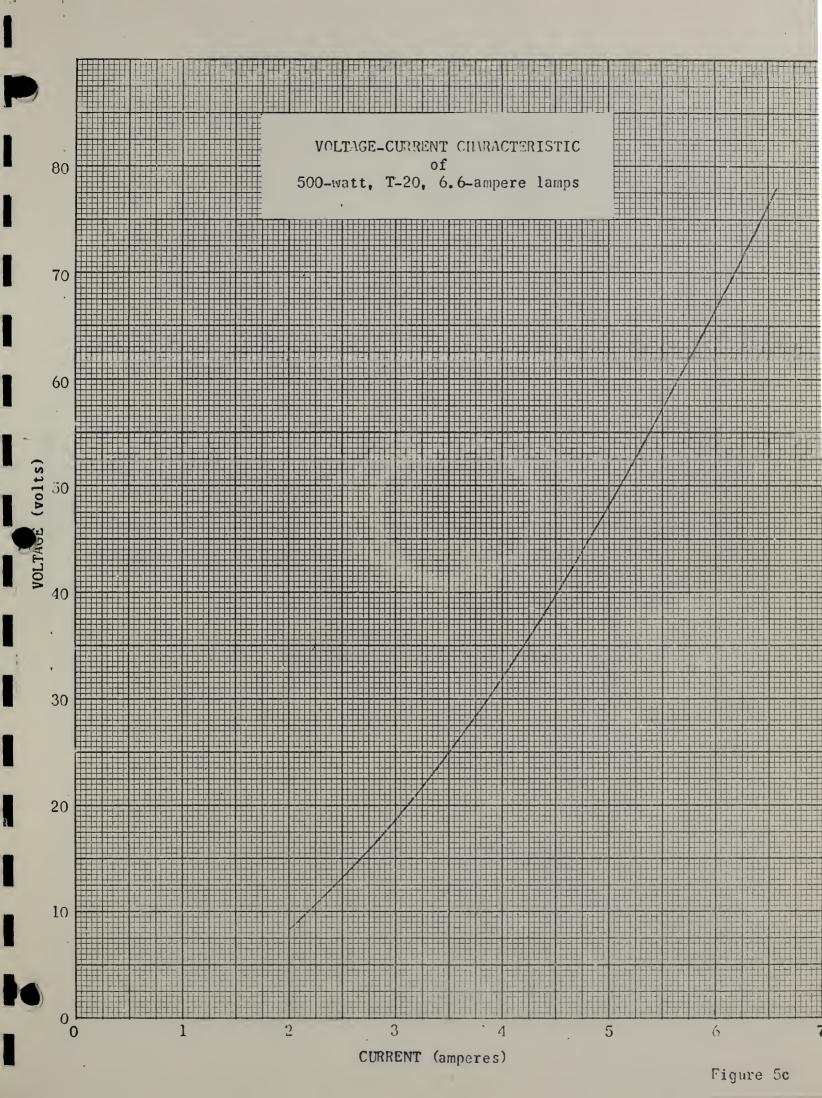




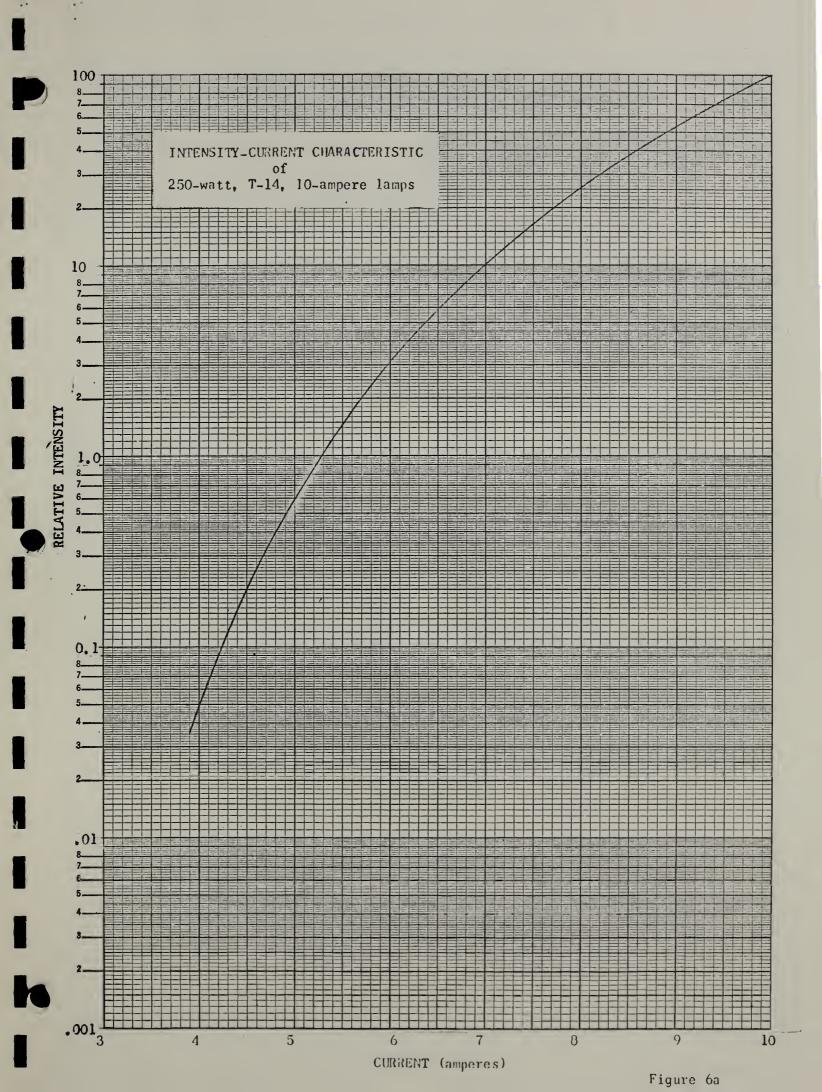


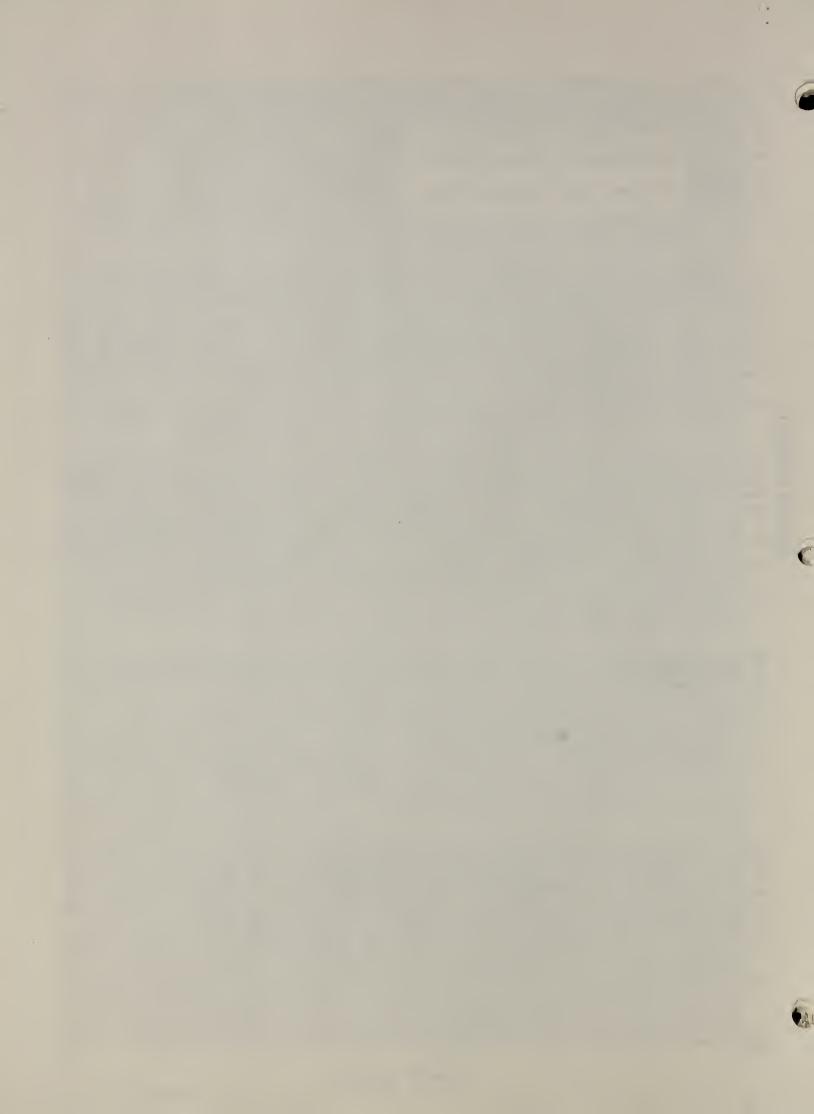


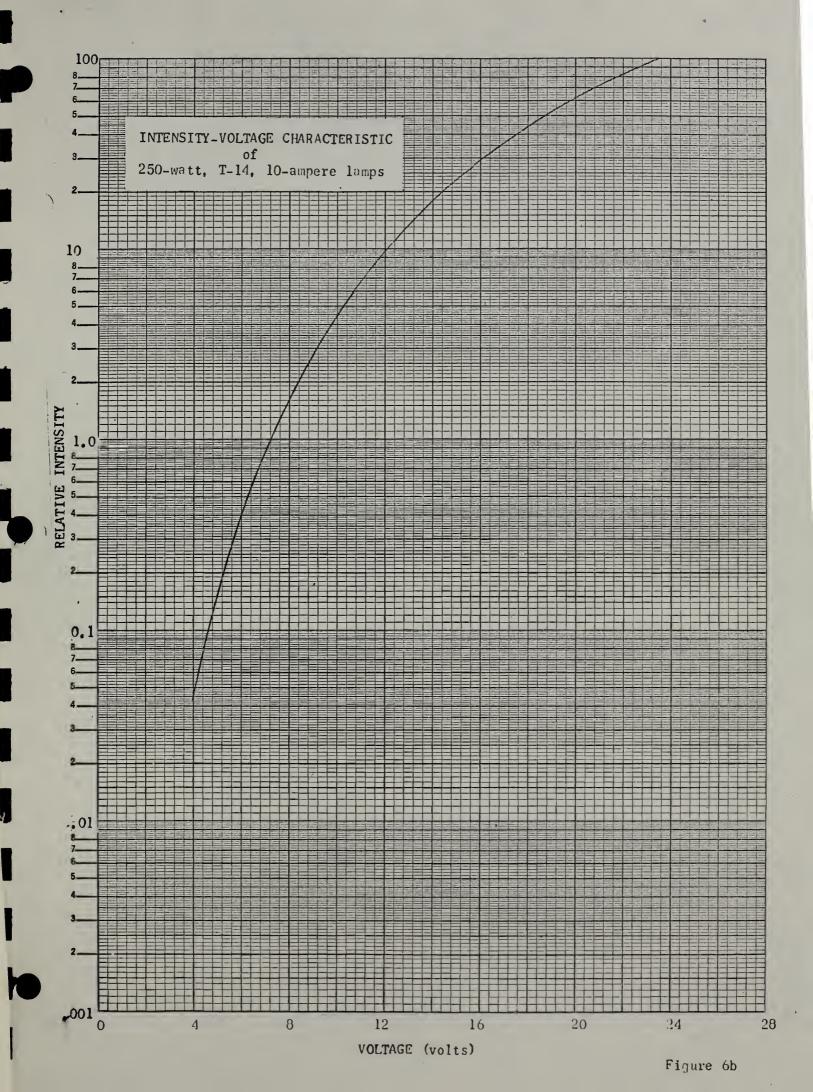


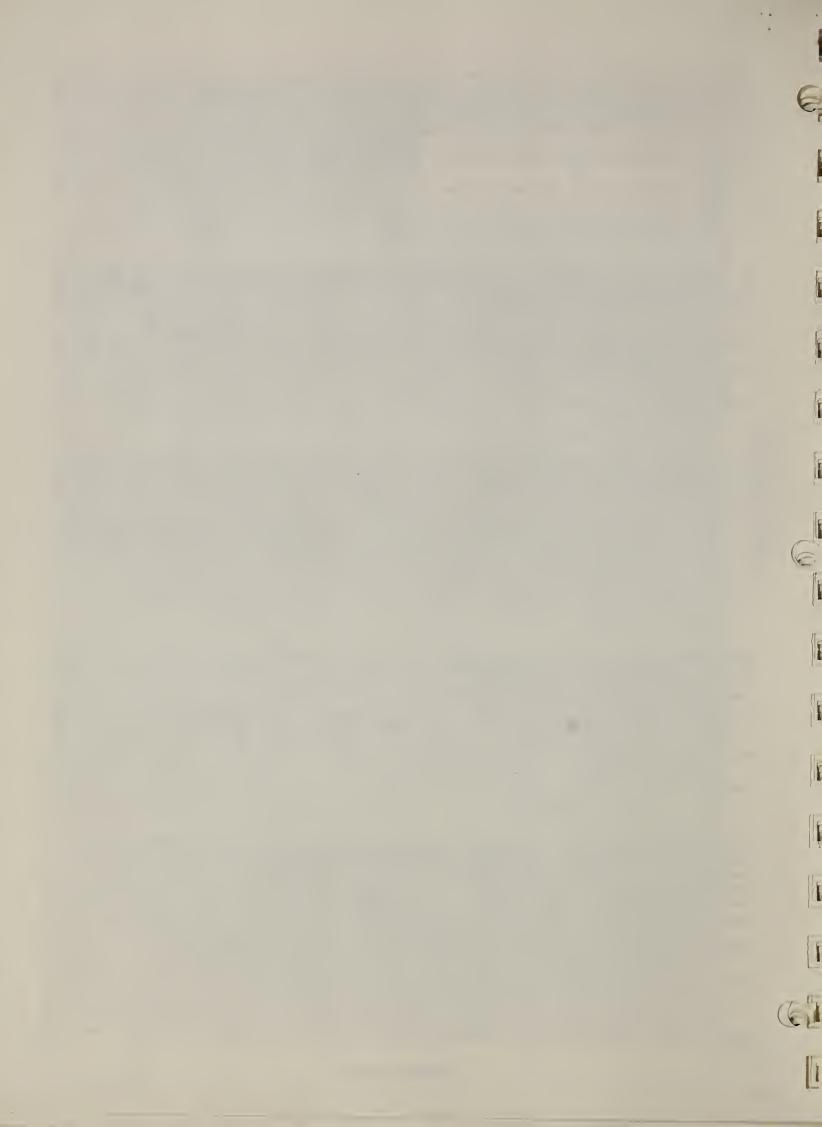


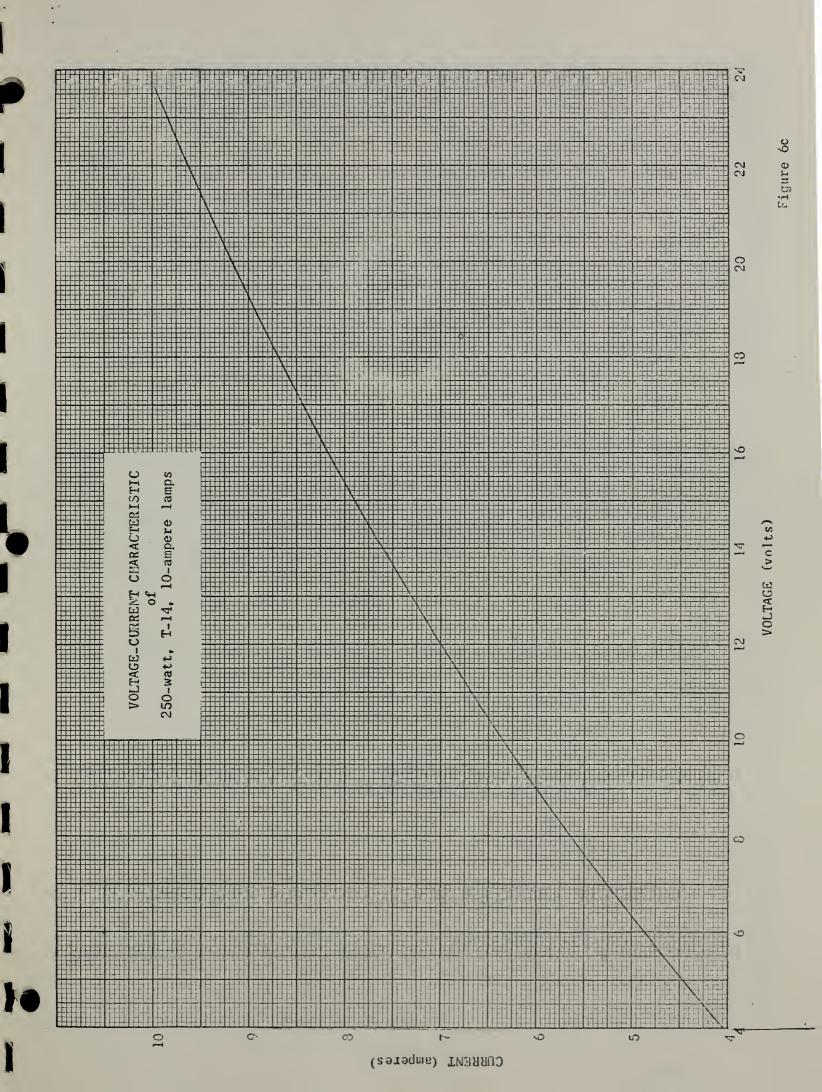


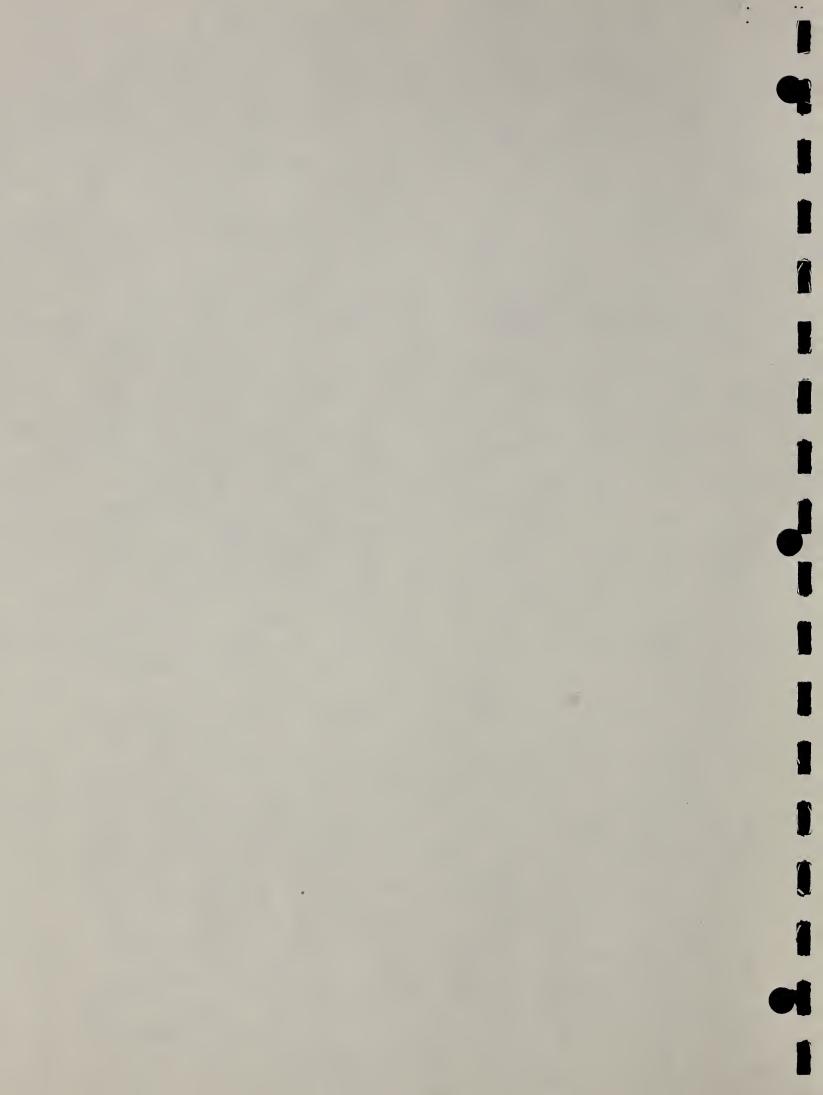


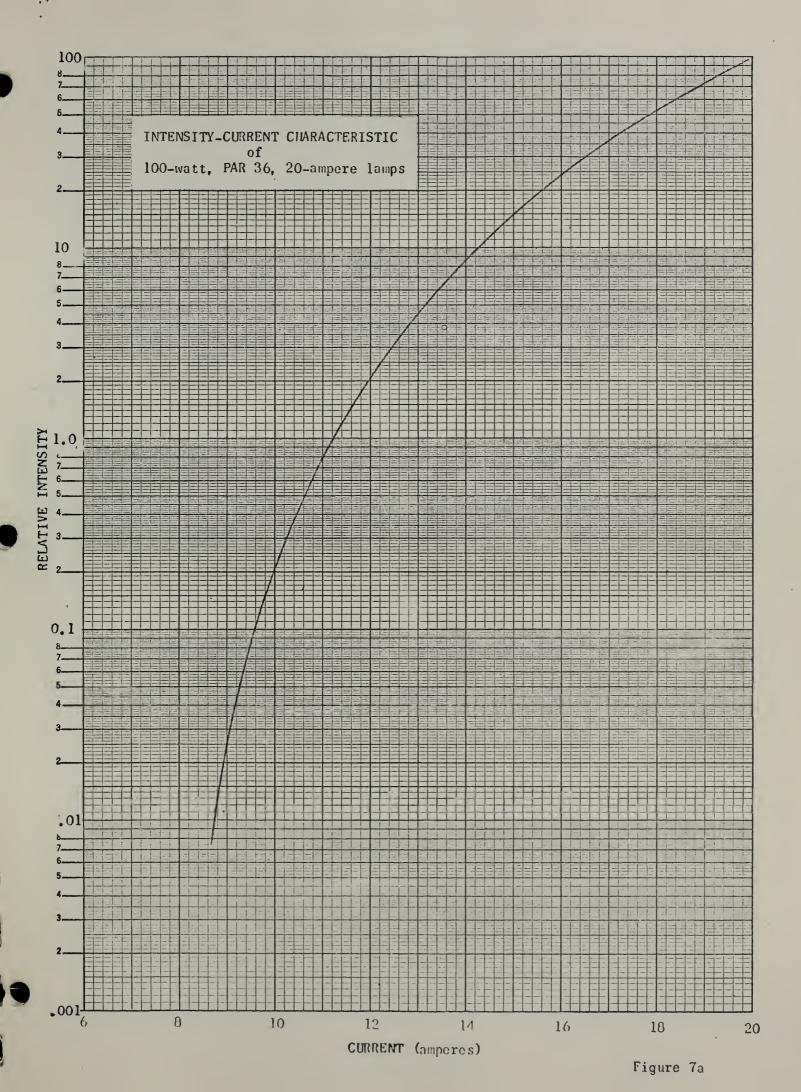


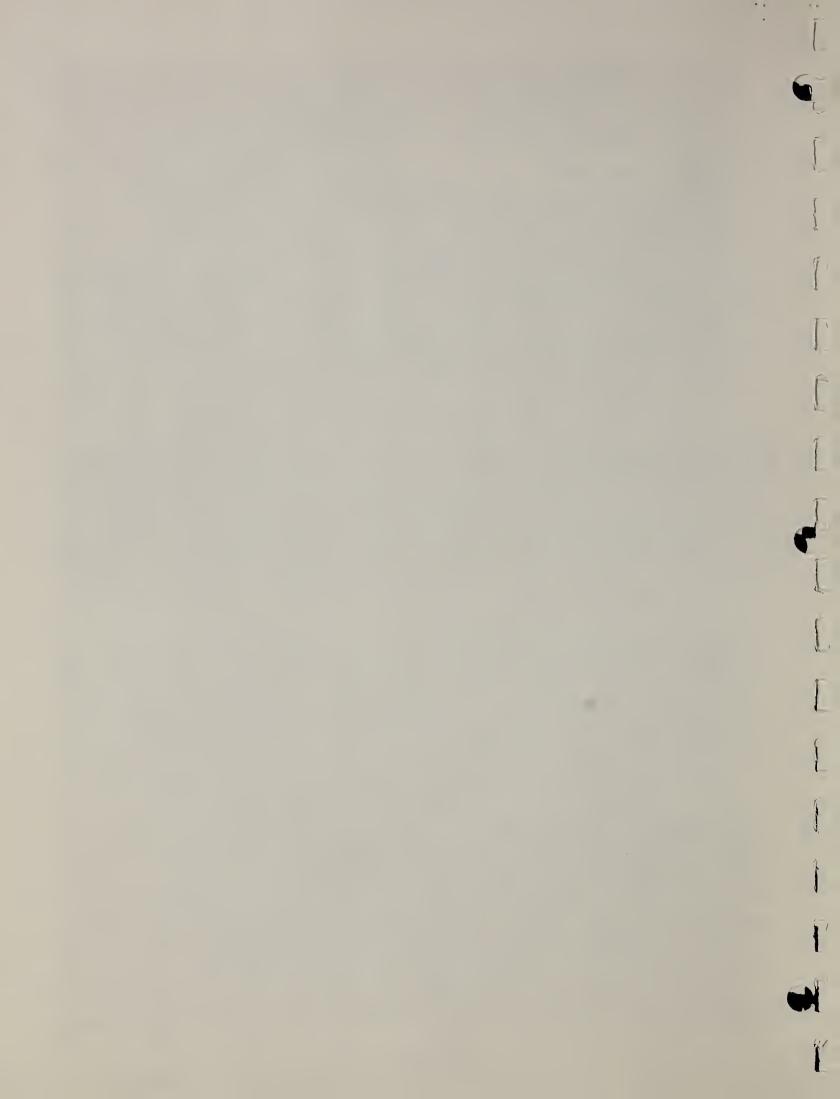


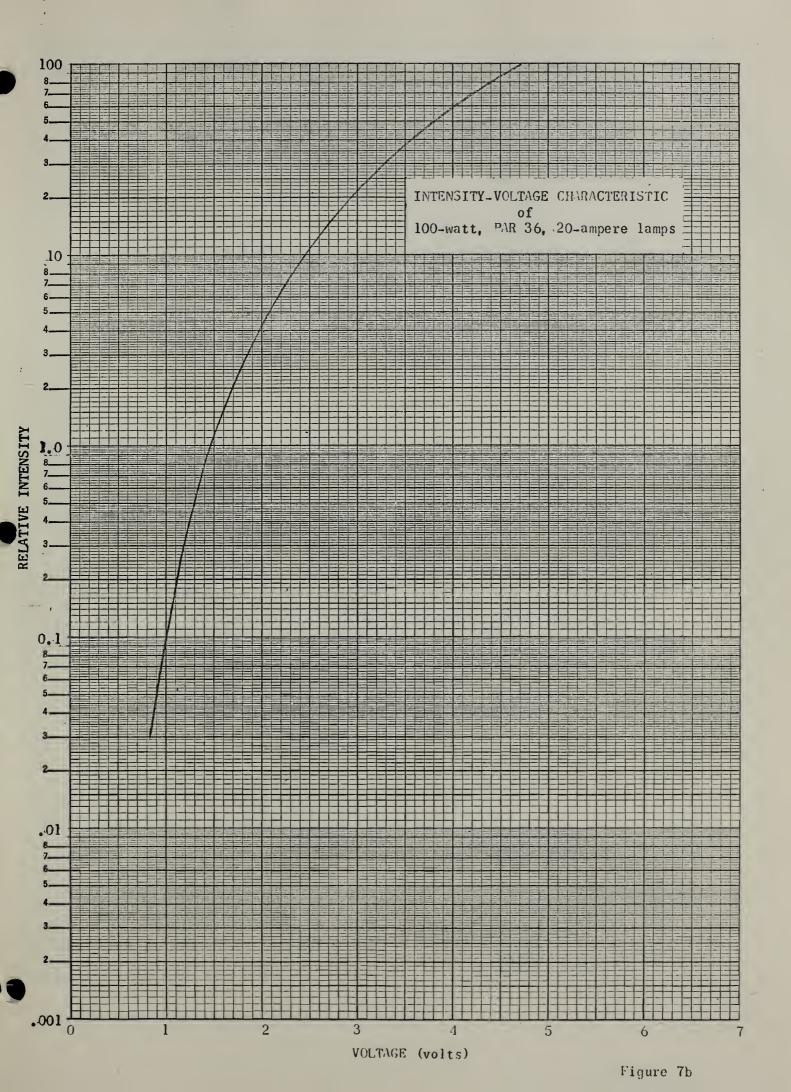


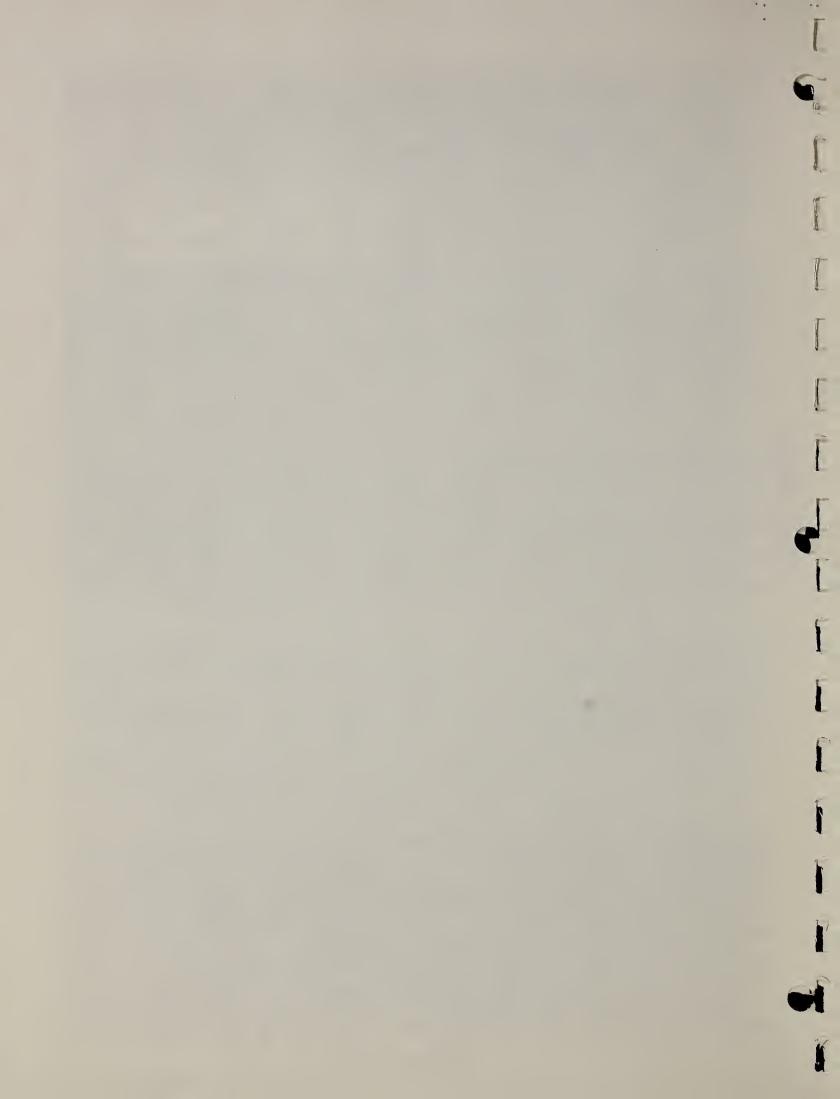


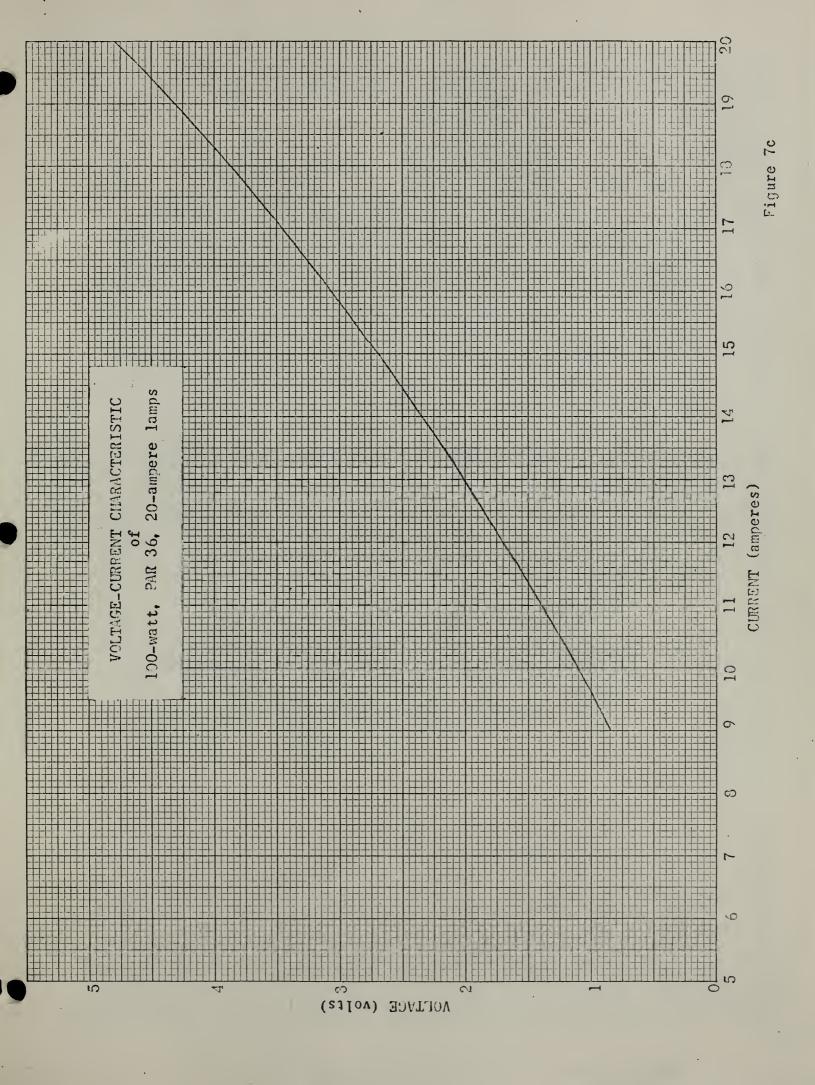


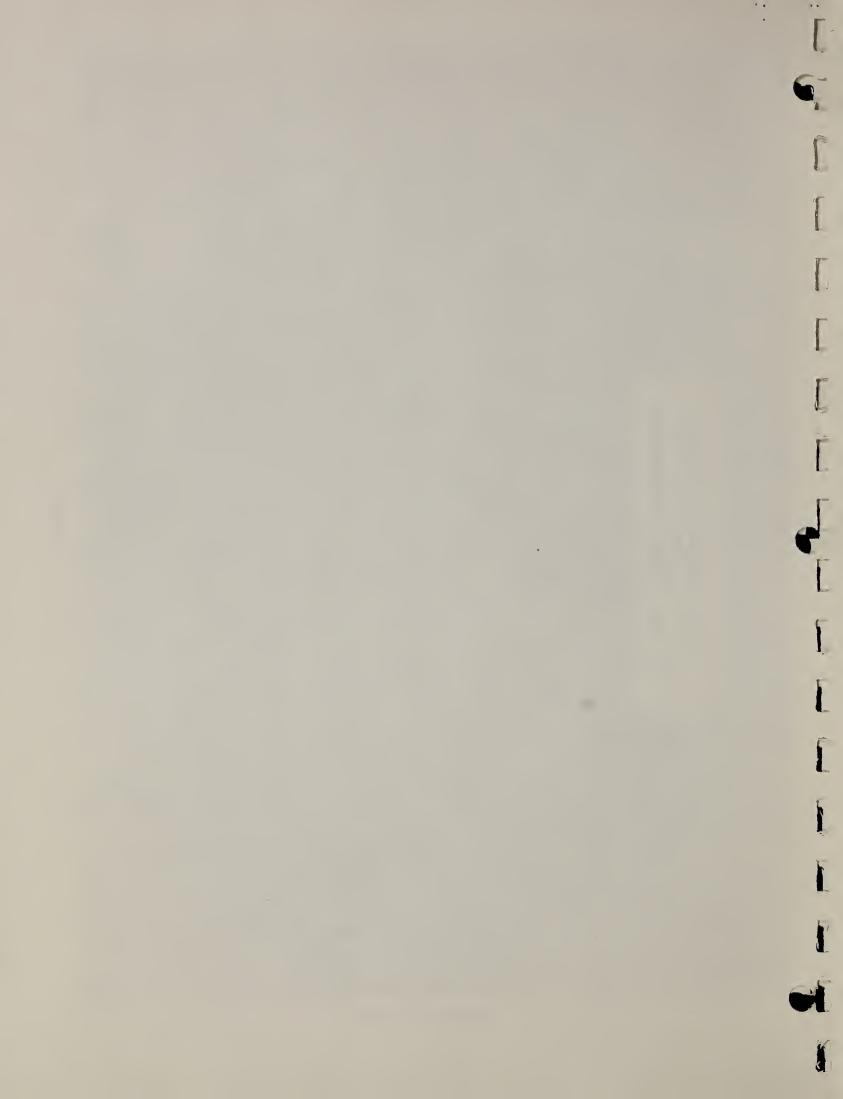


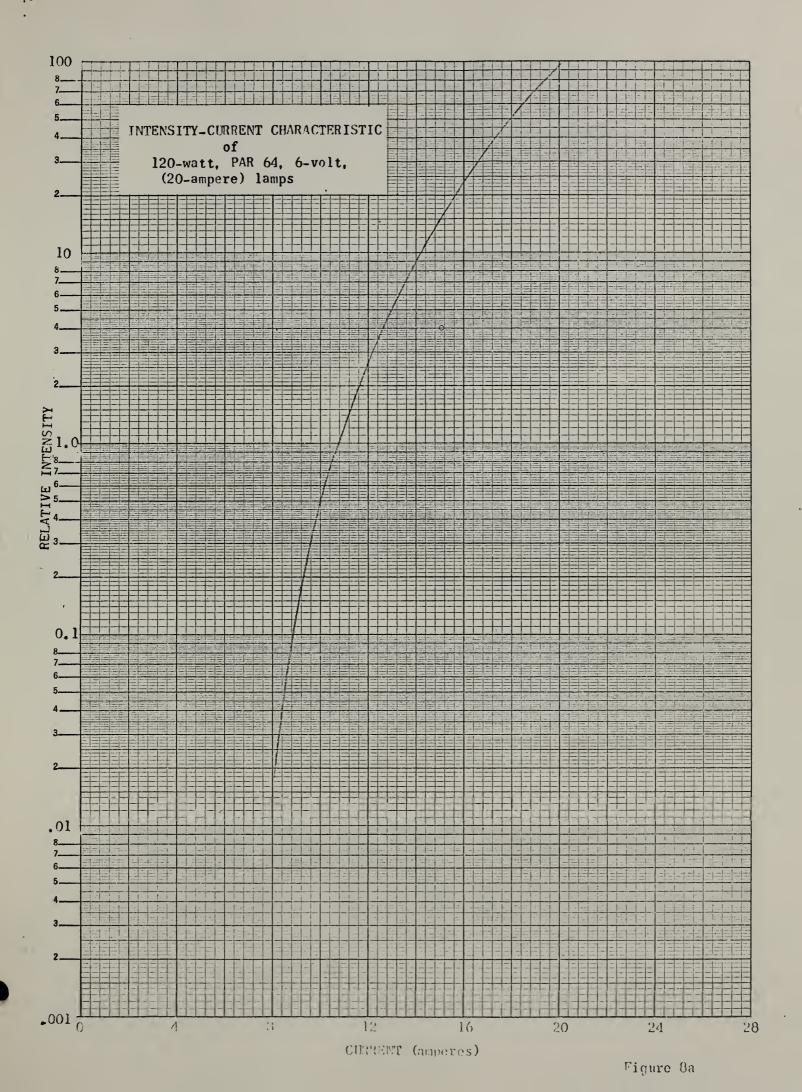


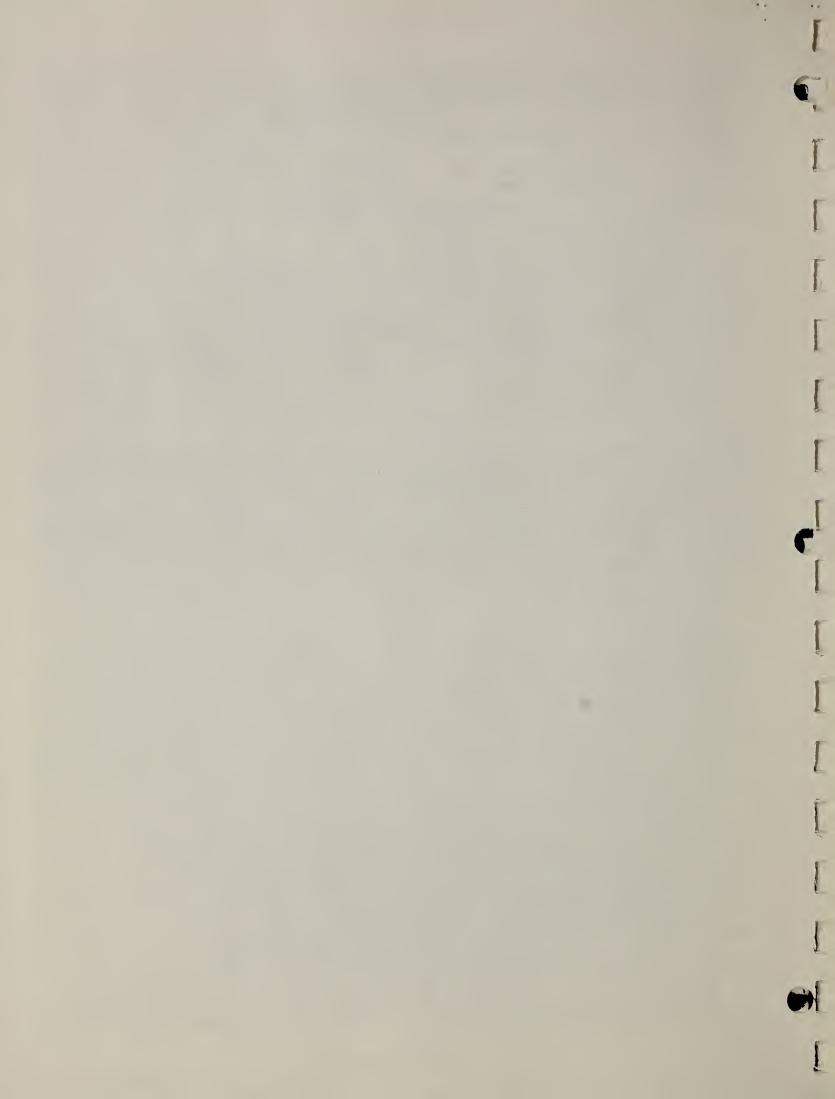


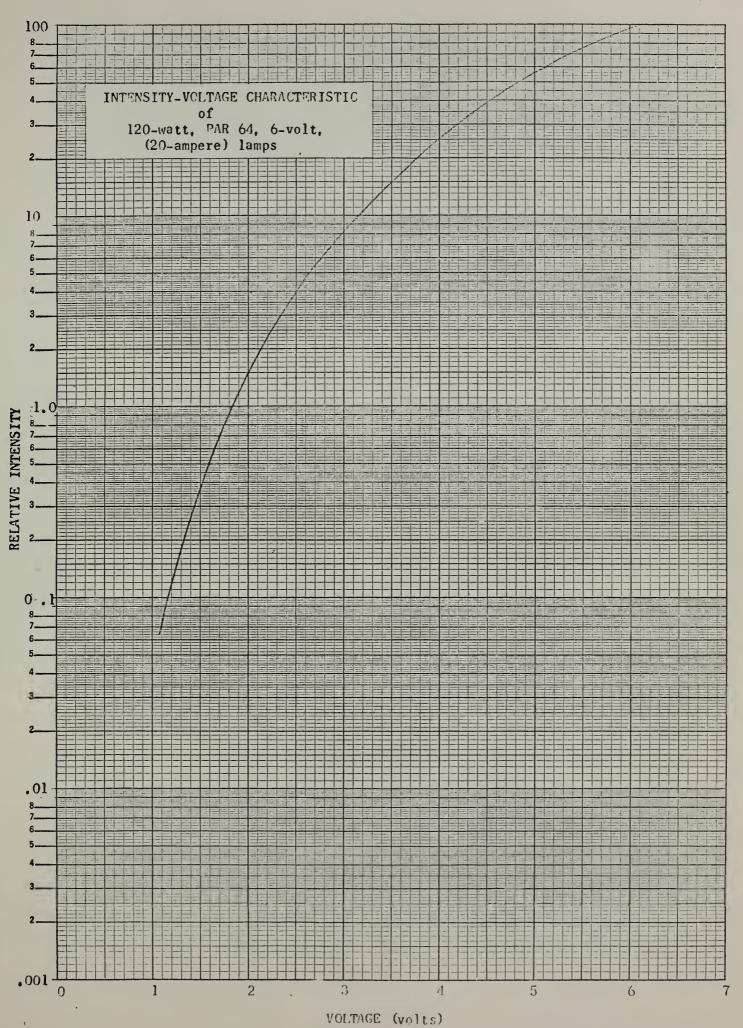


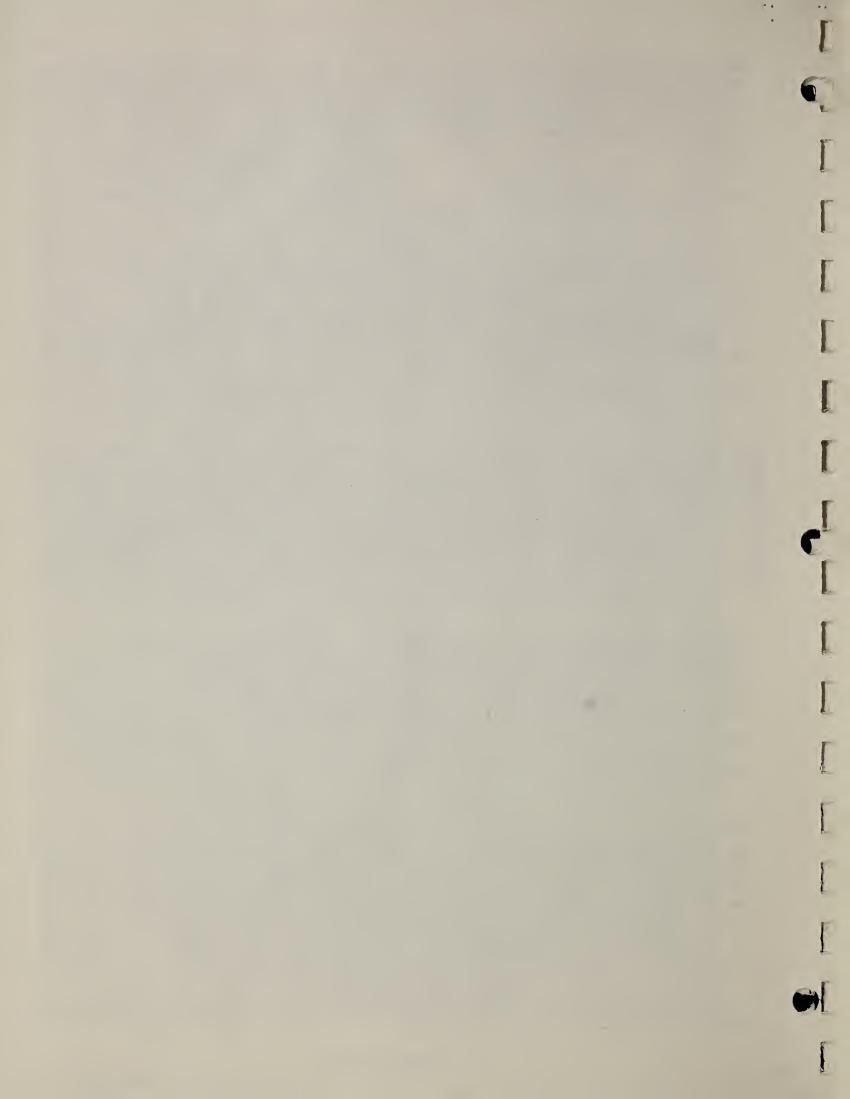




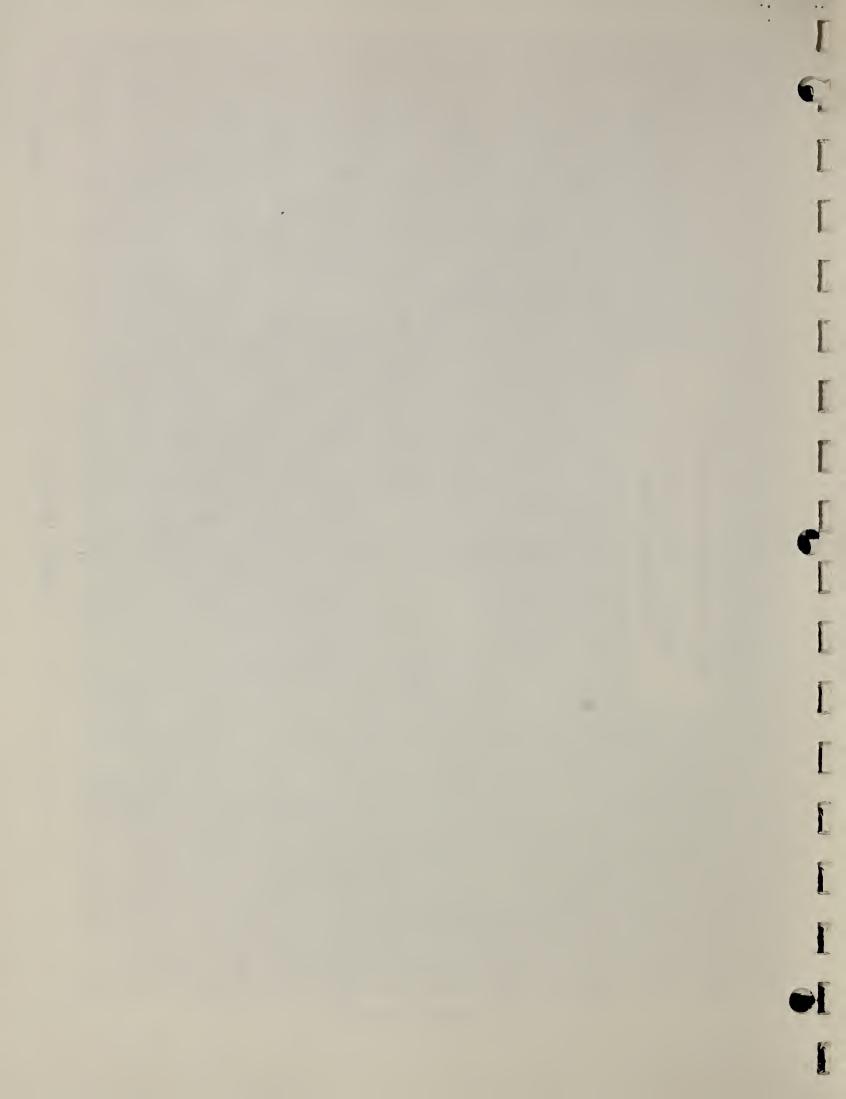


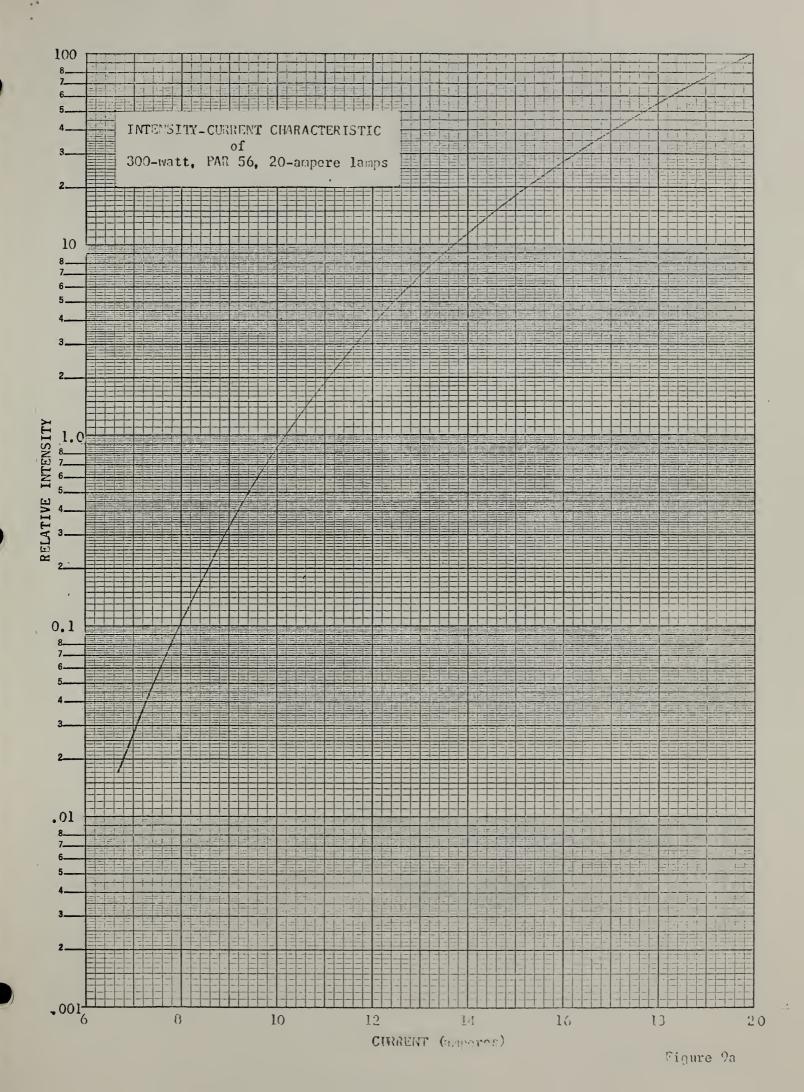


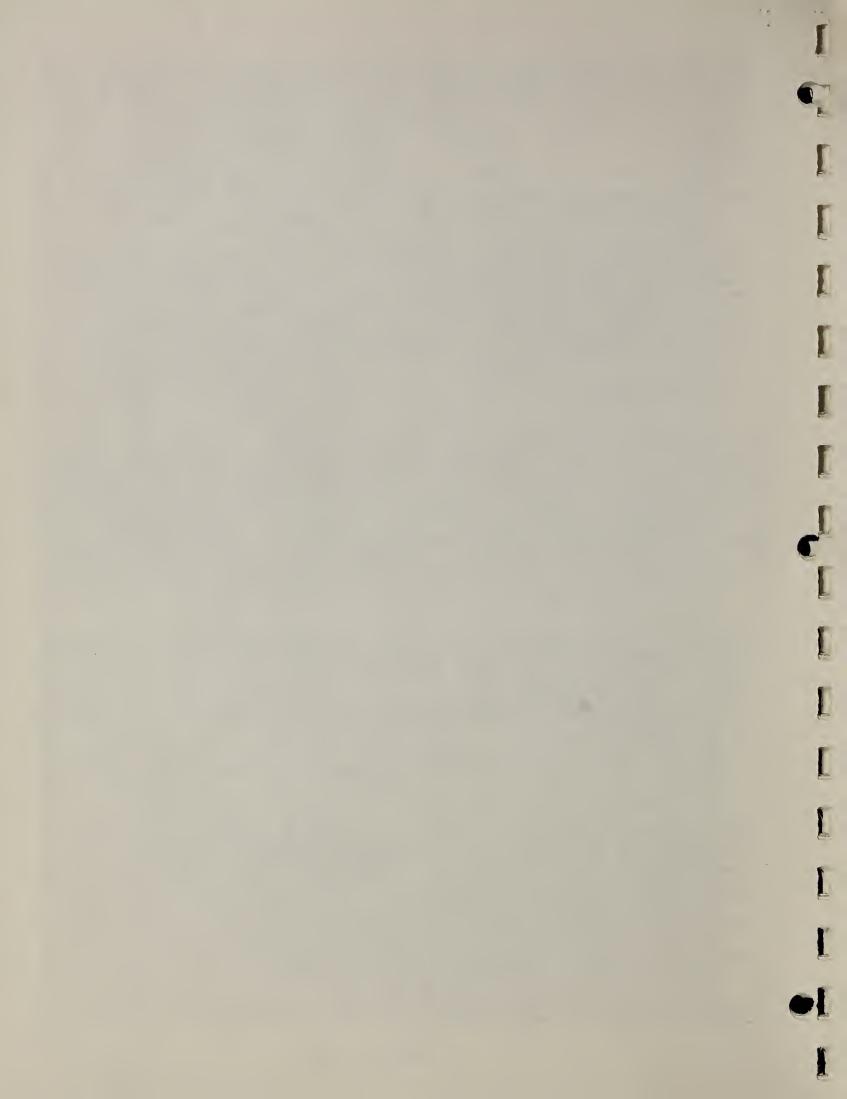


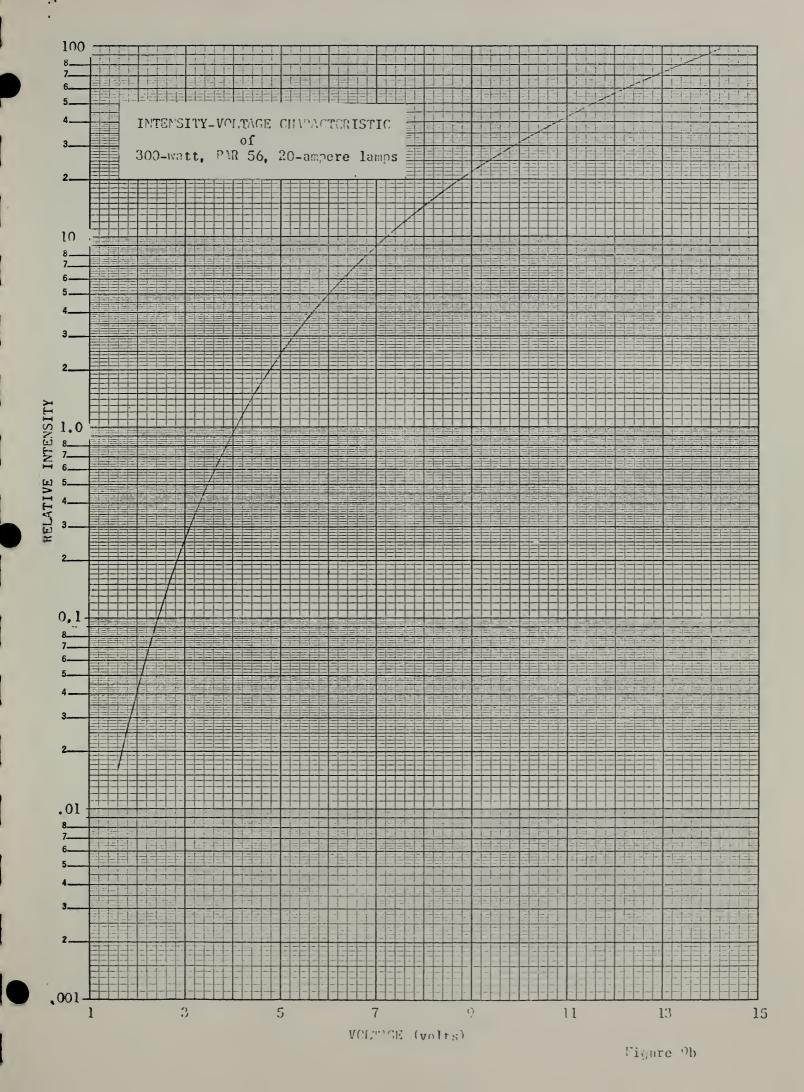


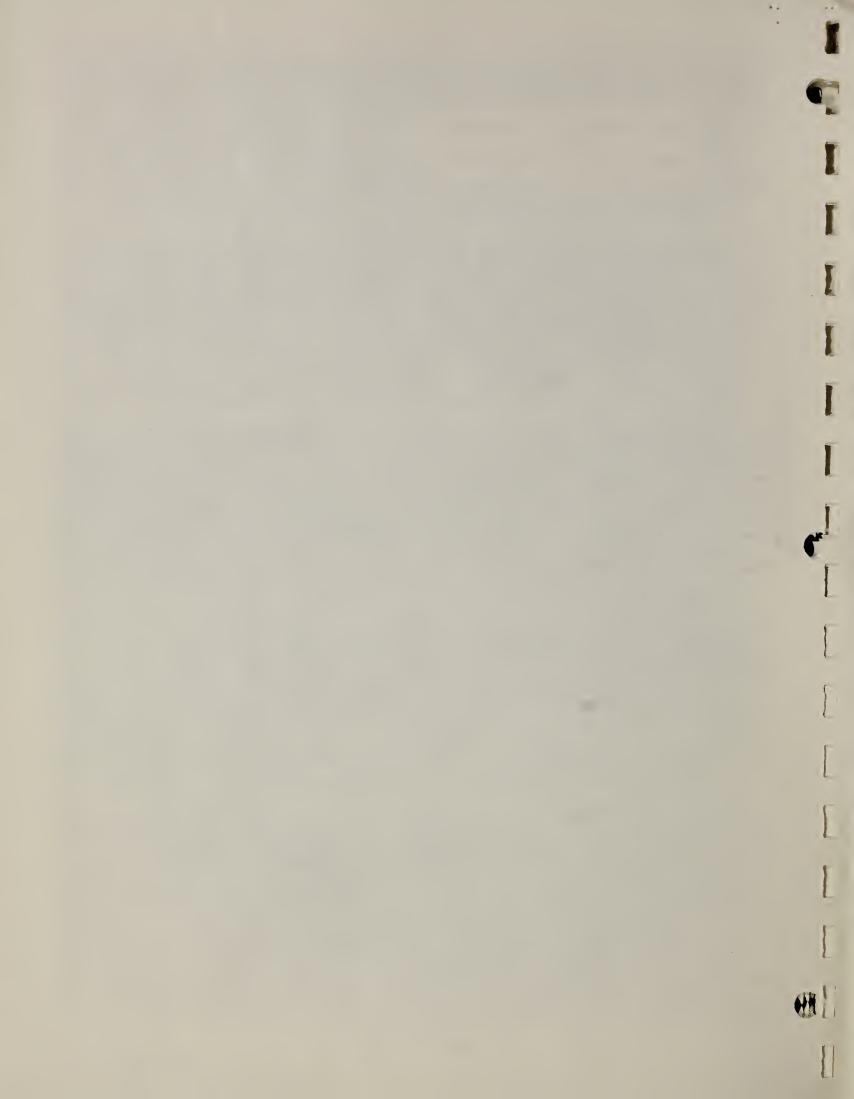
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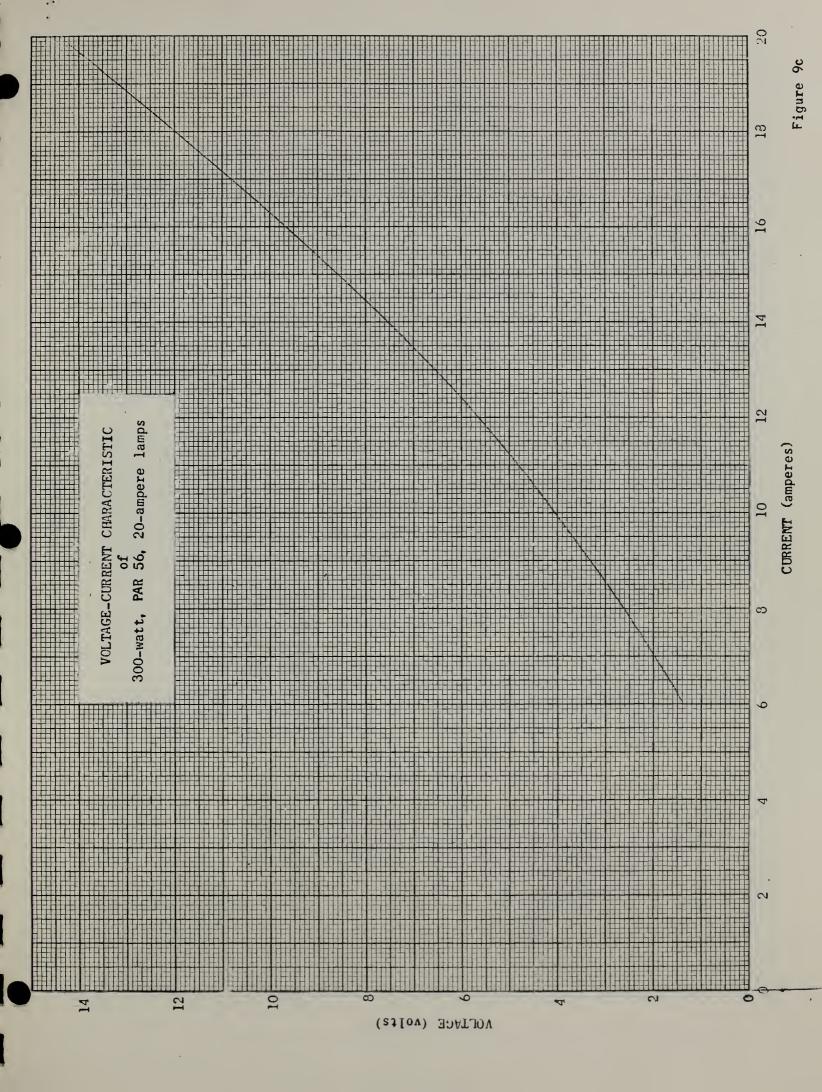












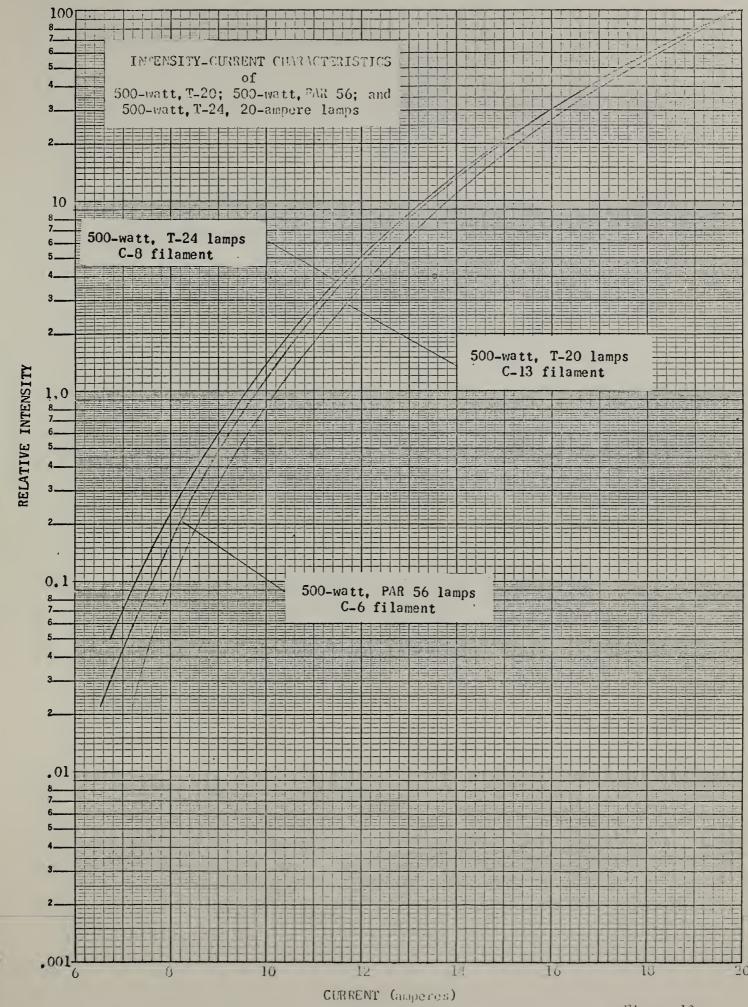
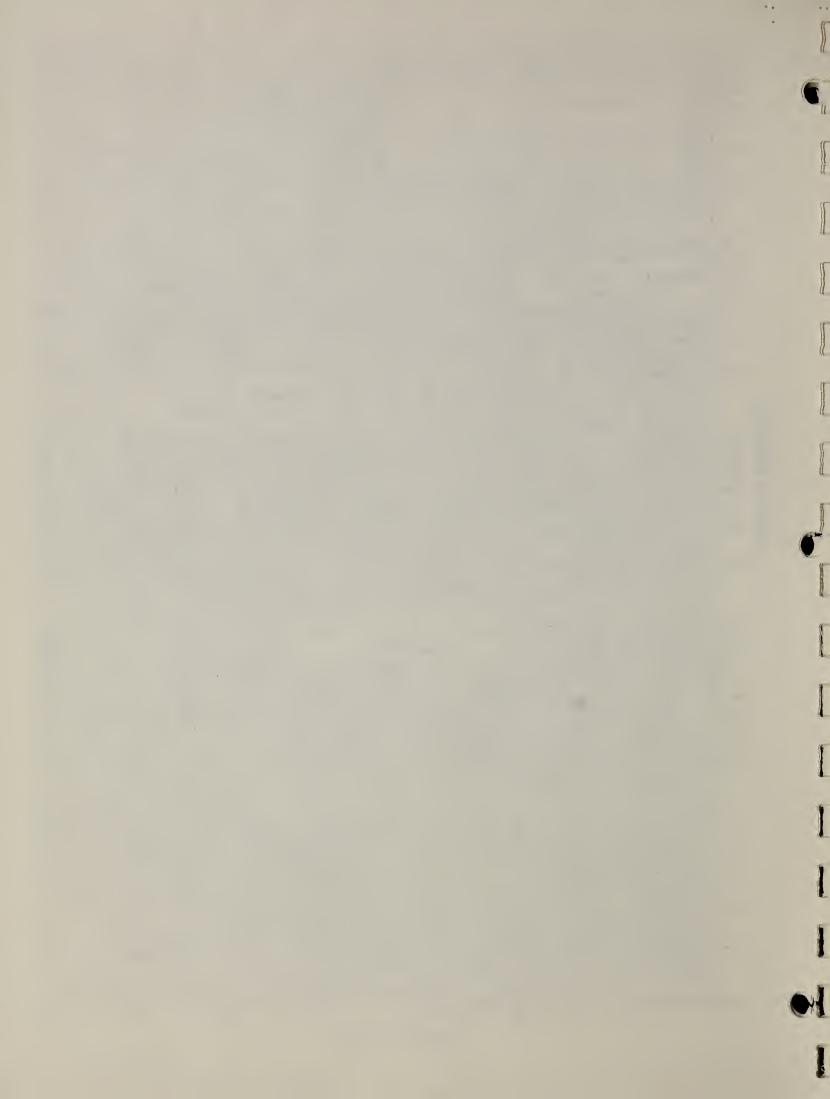
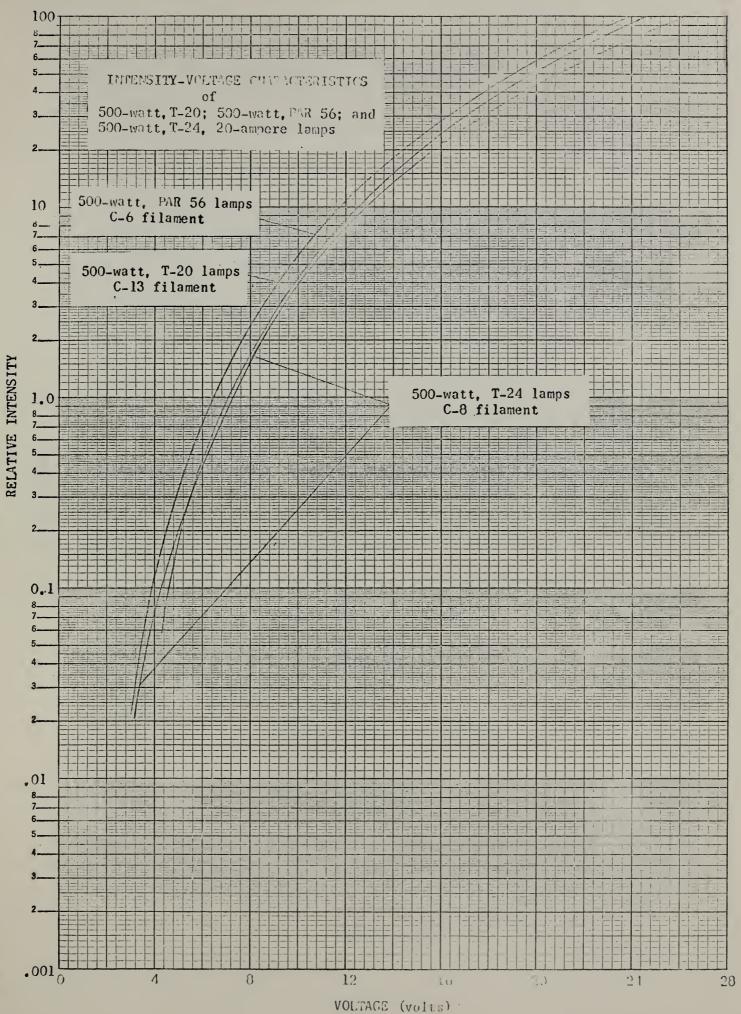
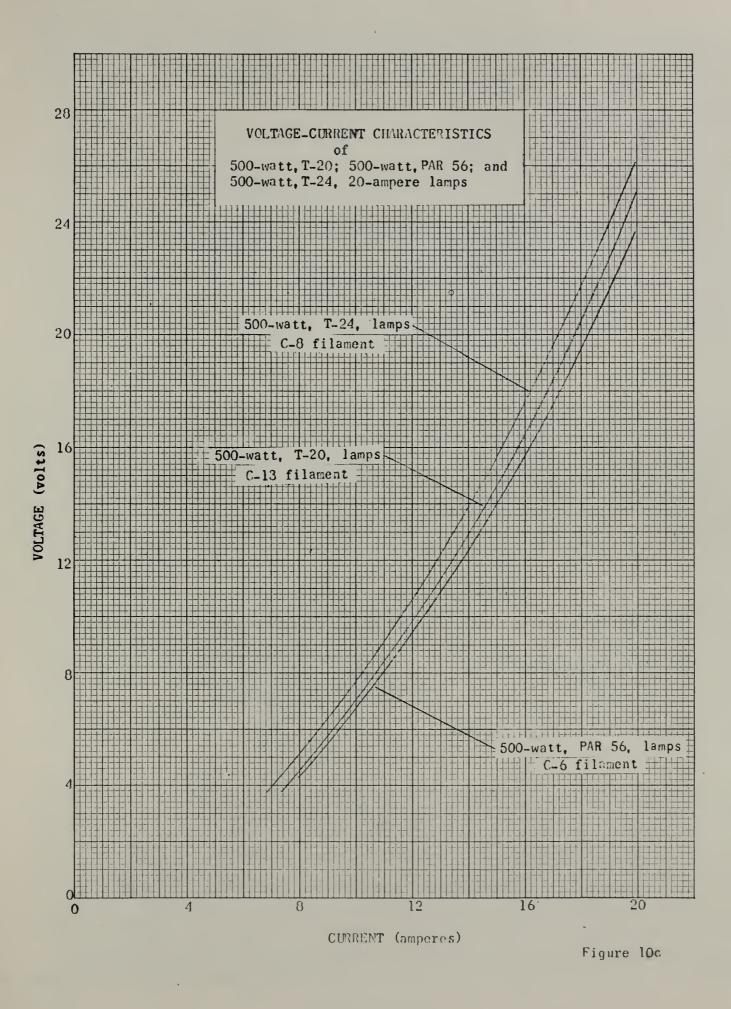


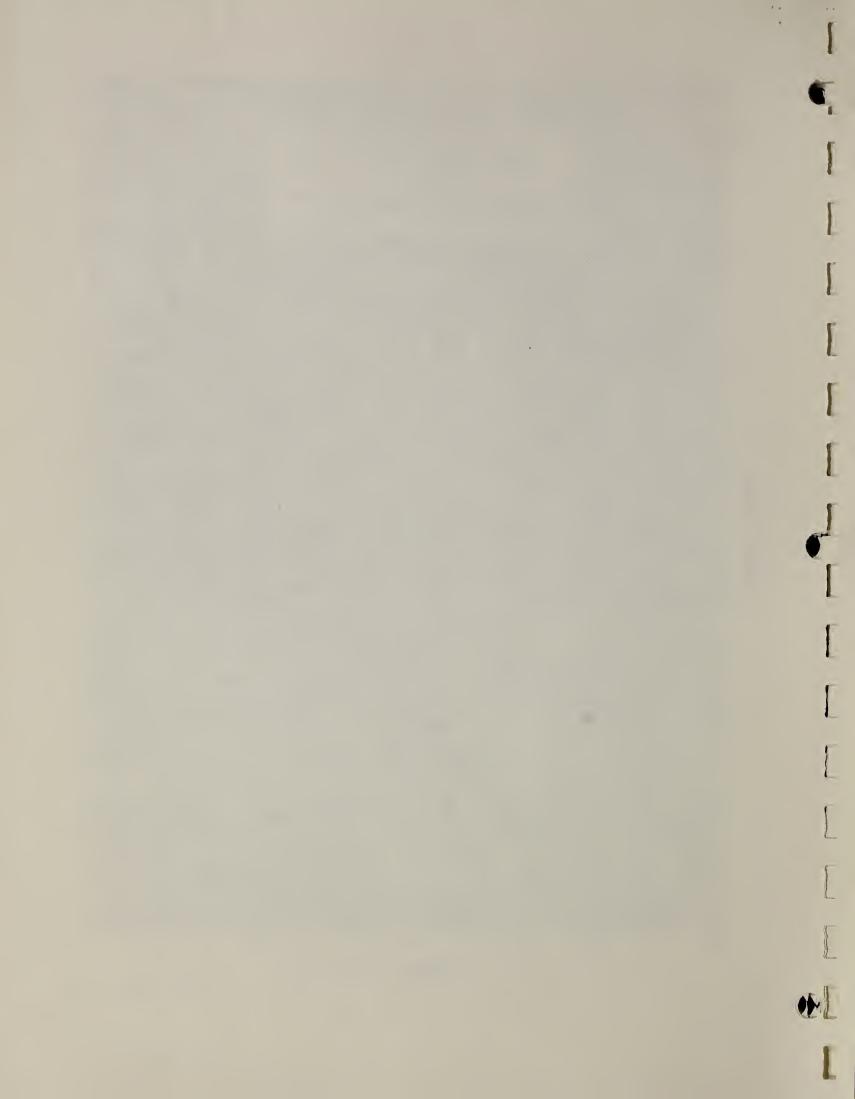
Figure 10a

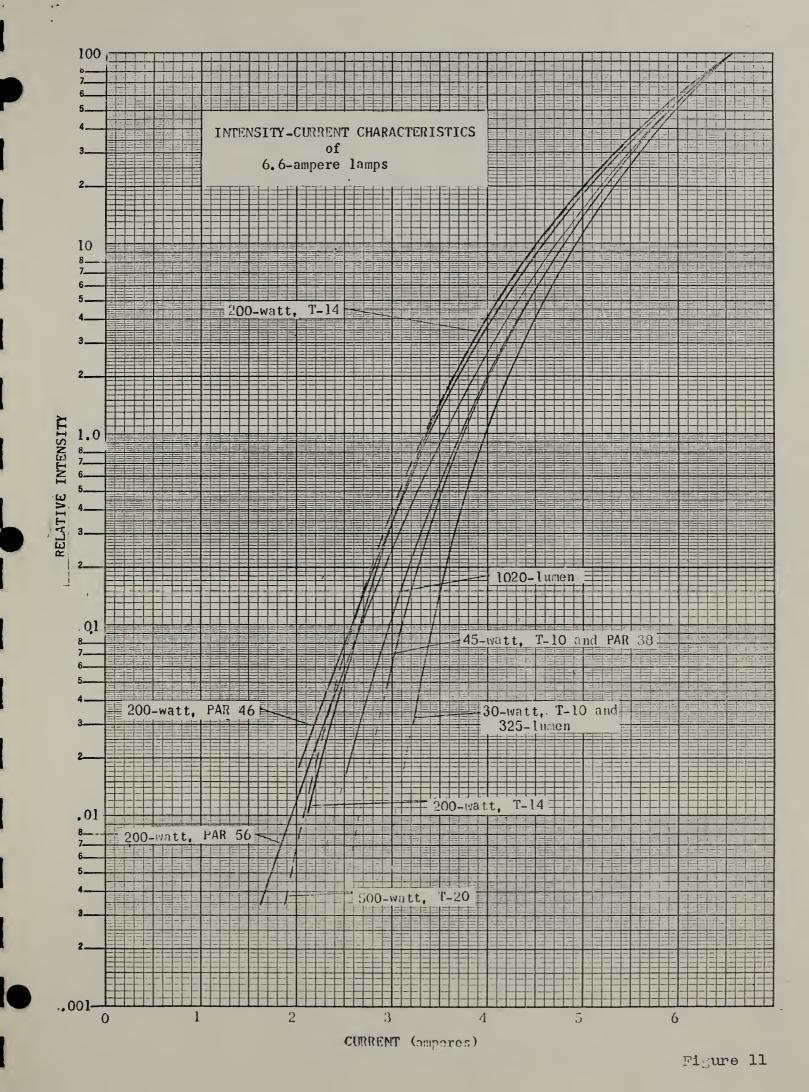


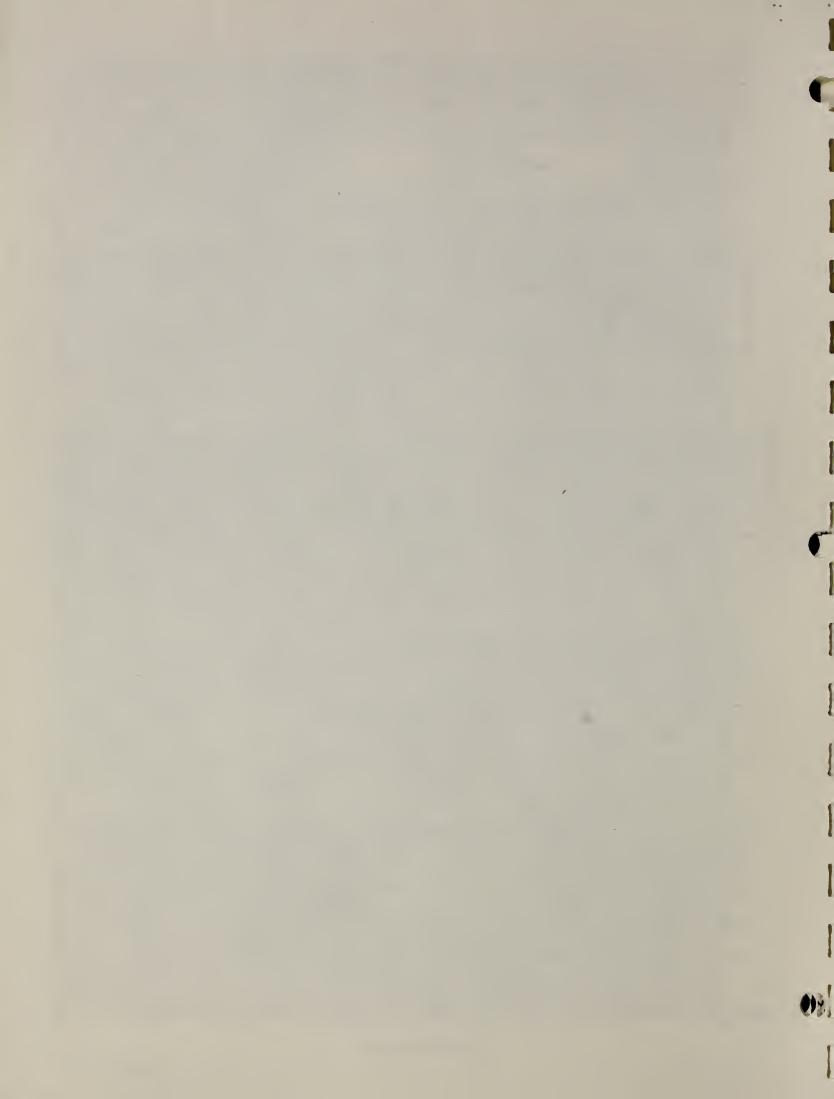


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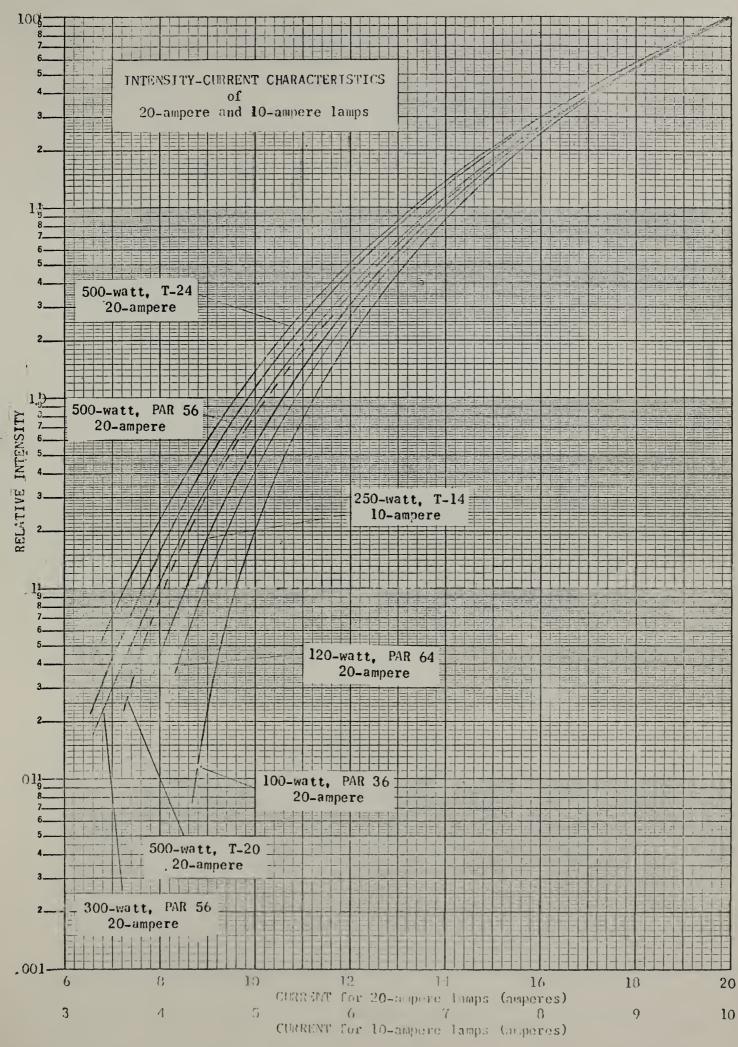
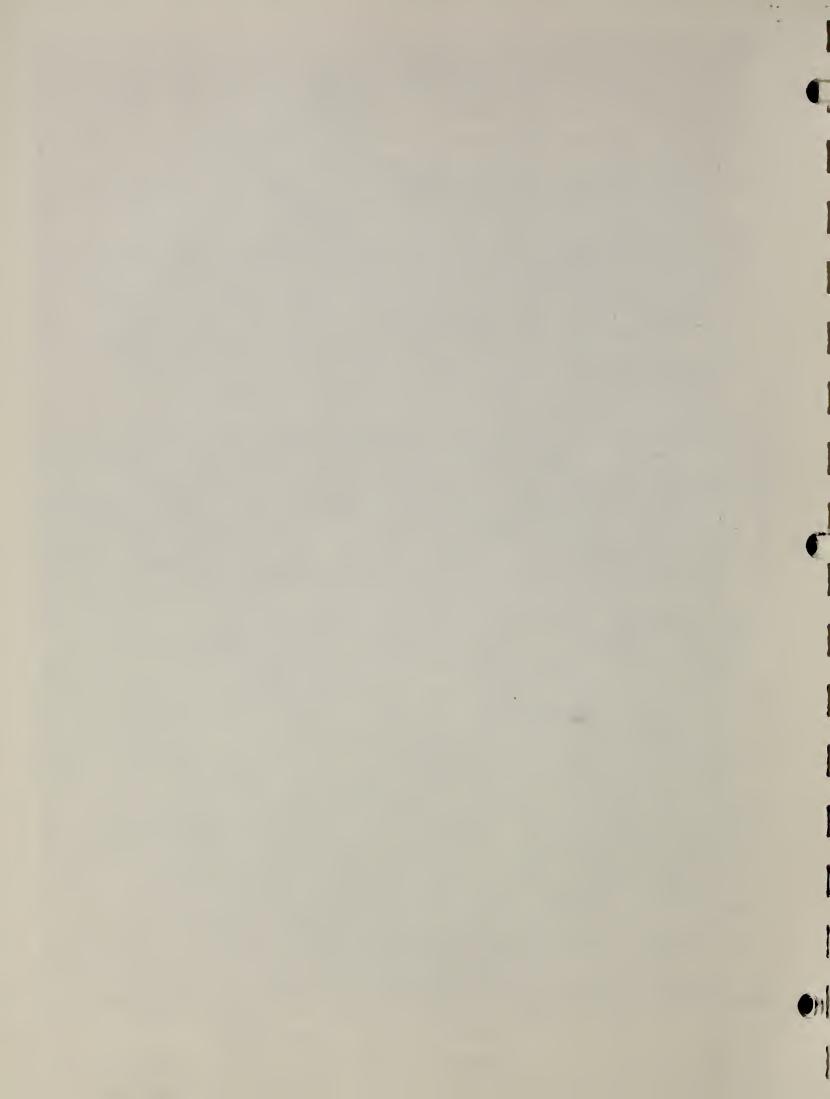
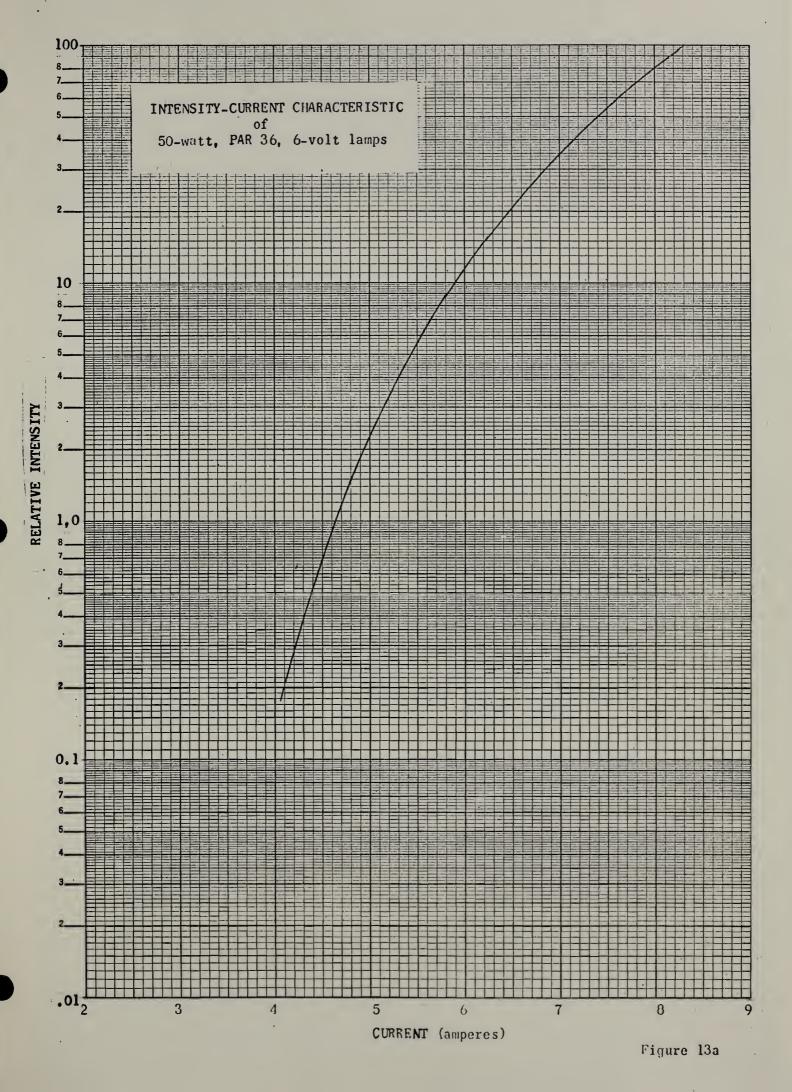
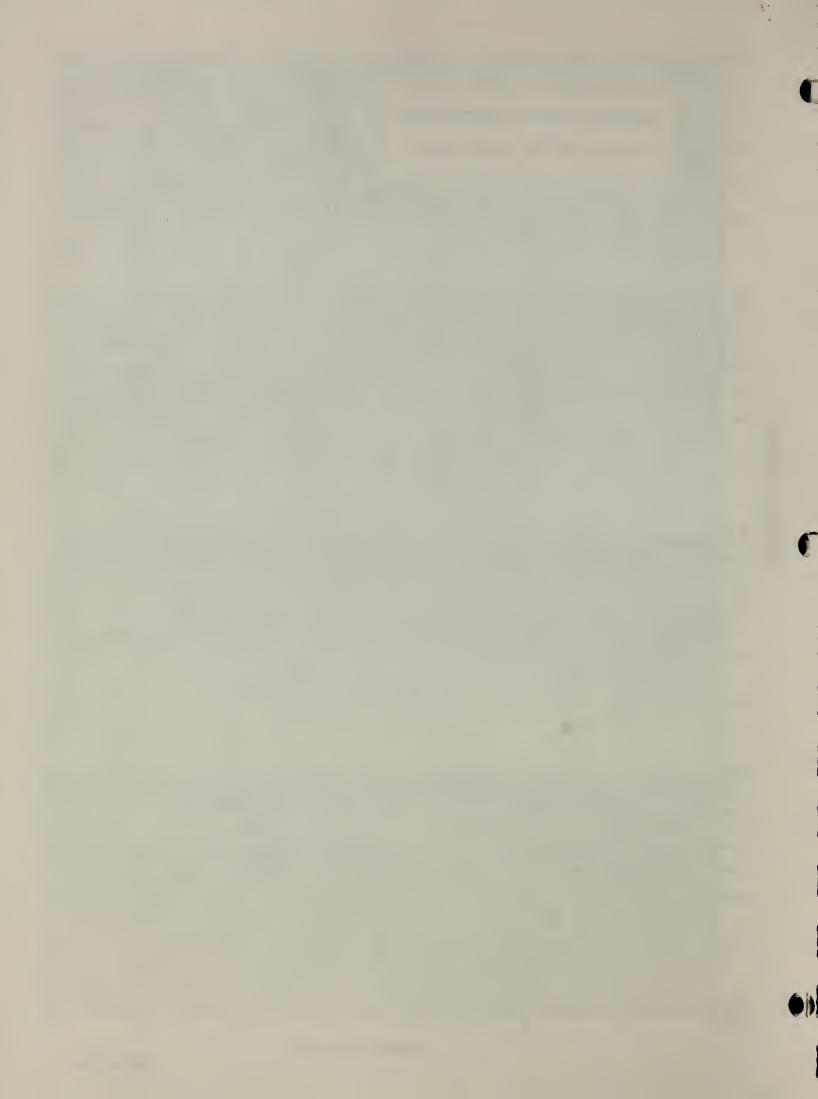
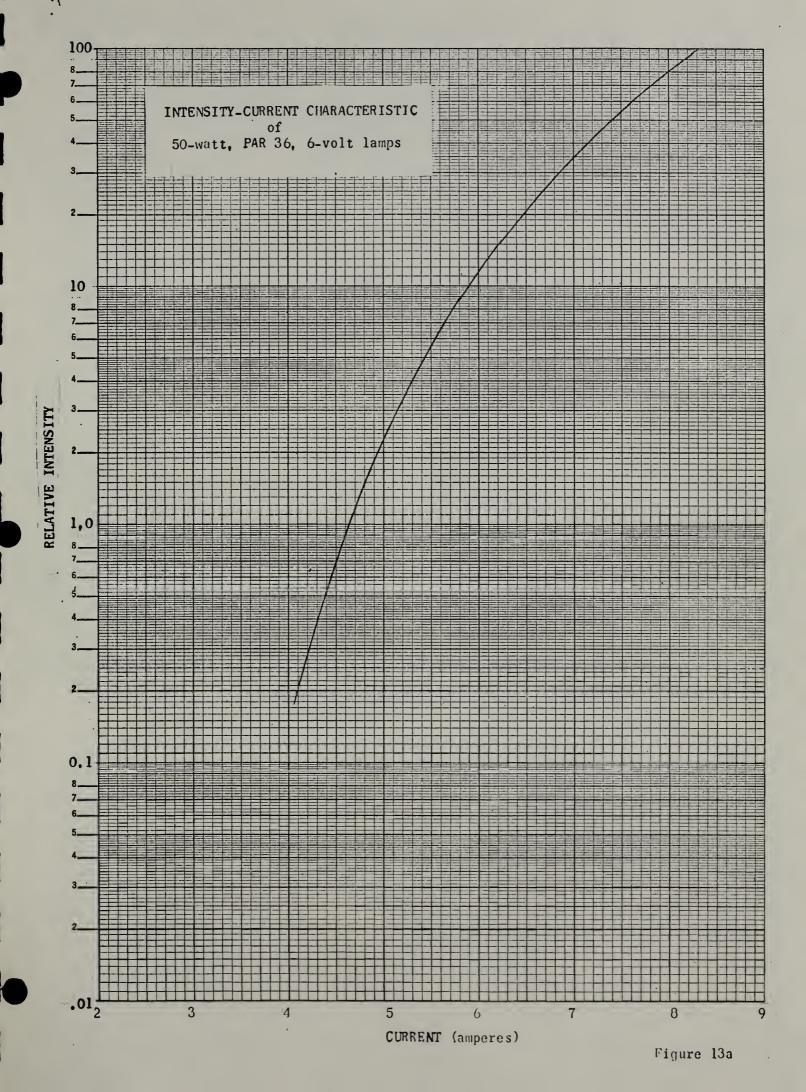


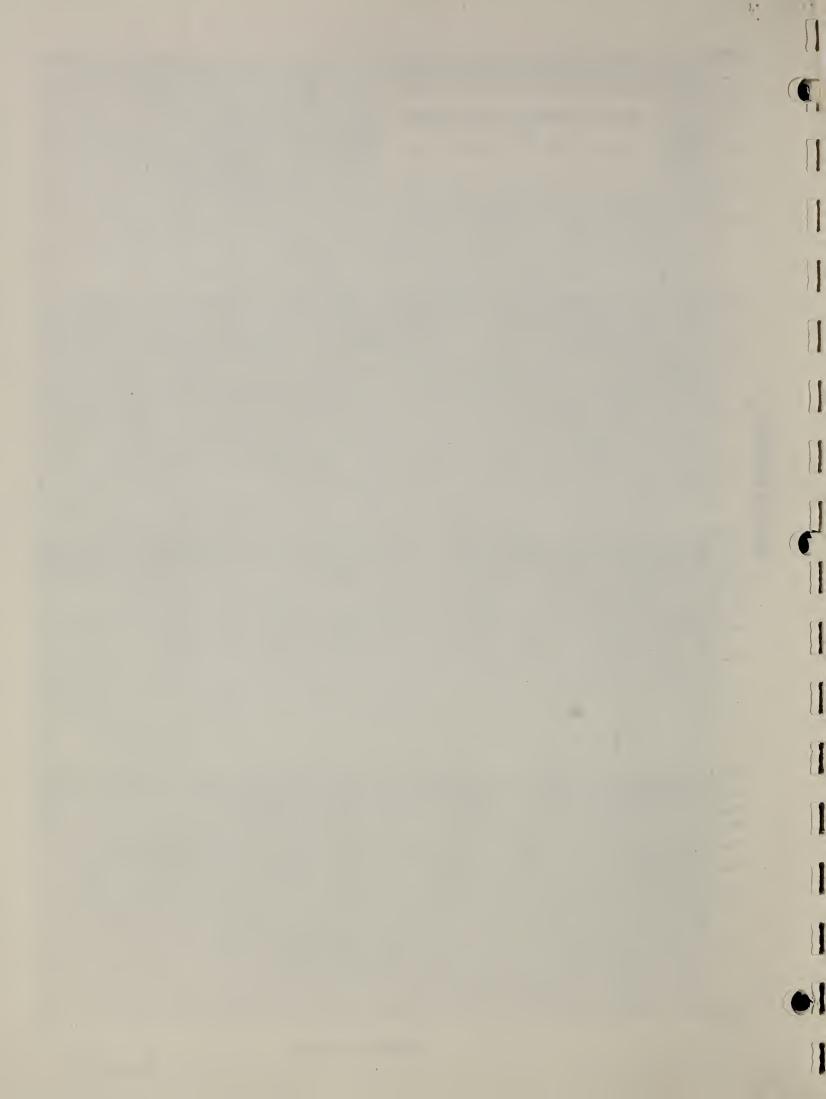
Figure 12

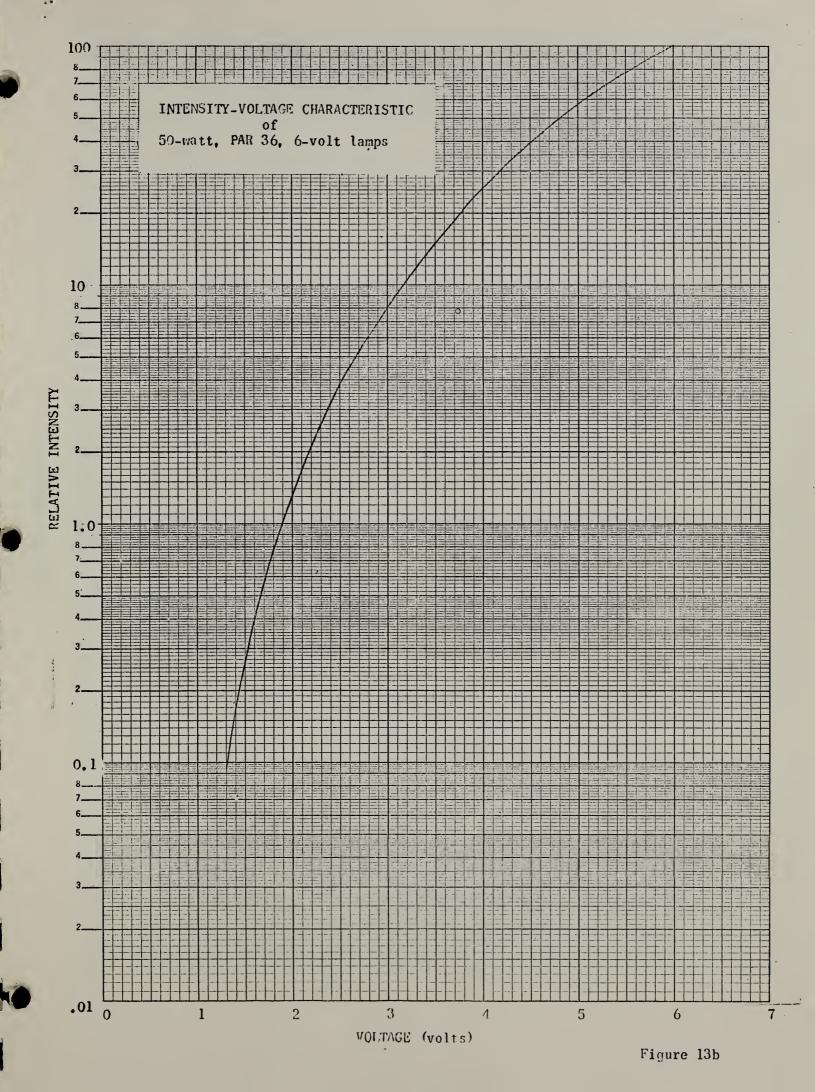


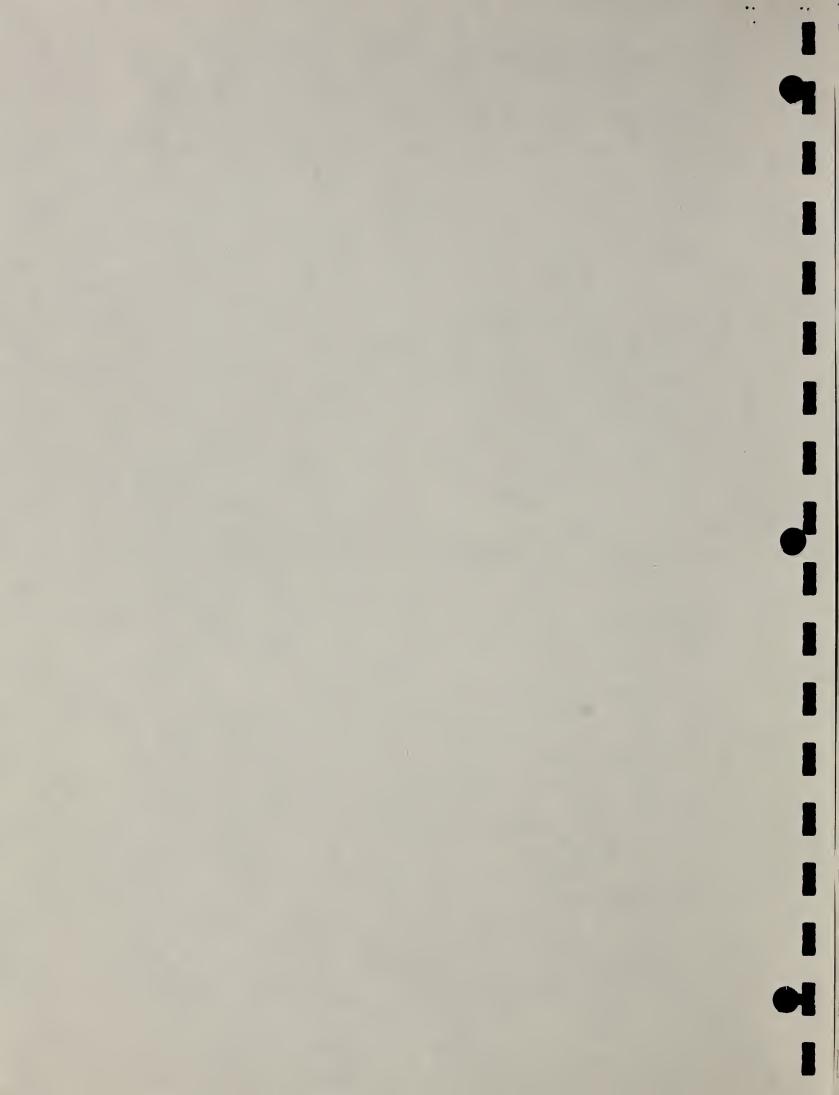


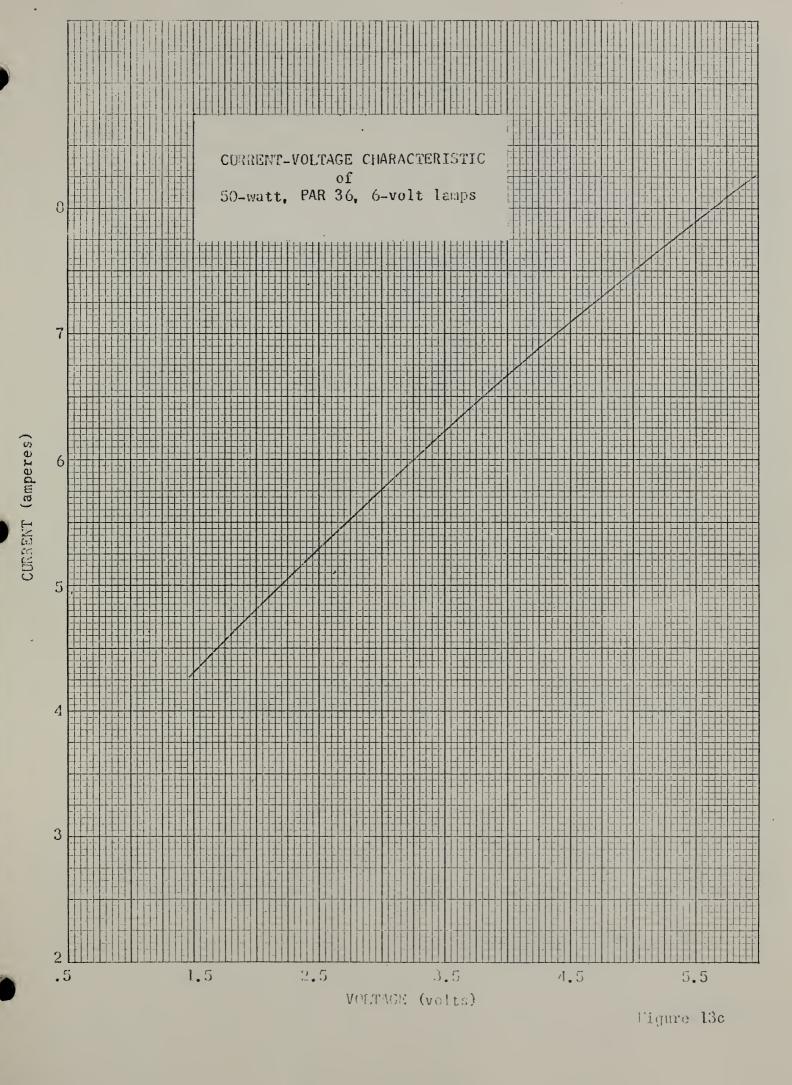


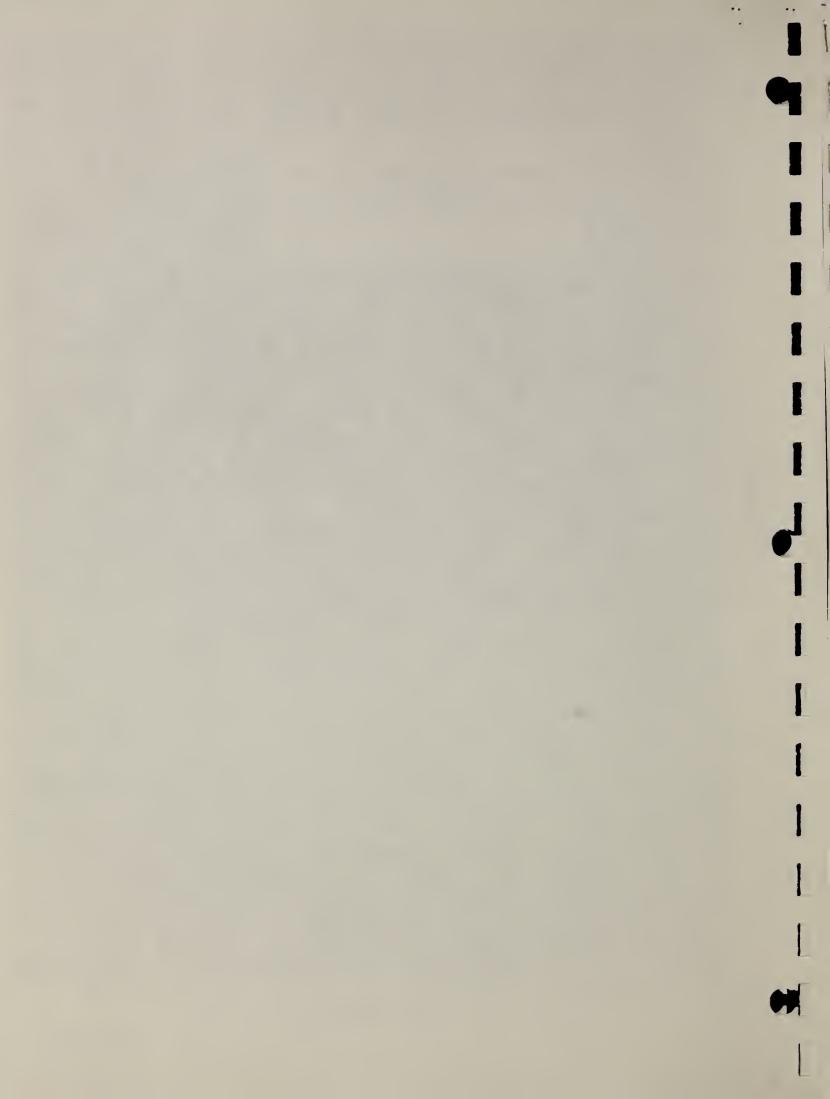












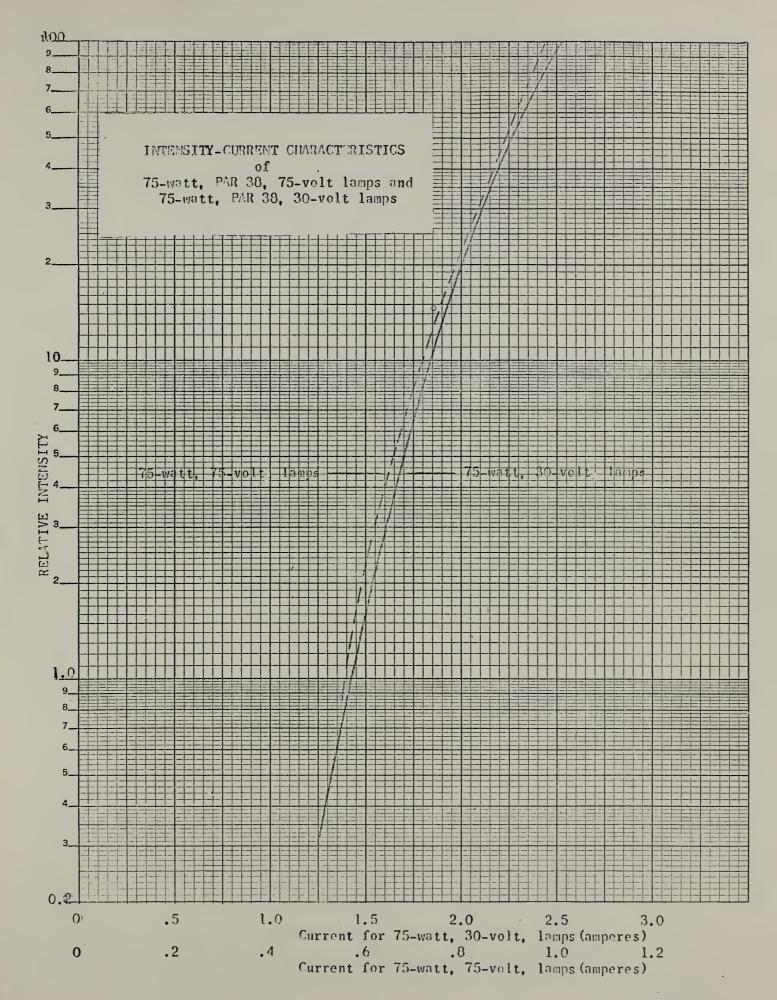
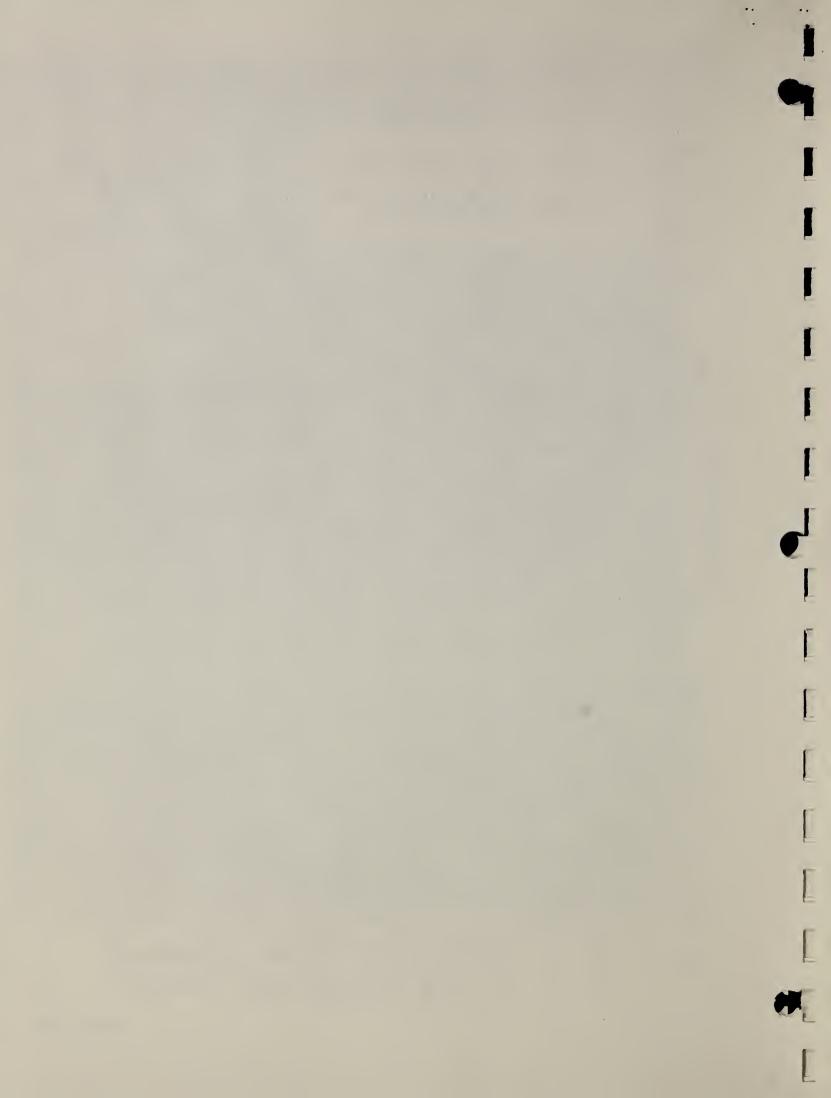


Figure 14a



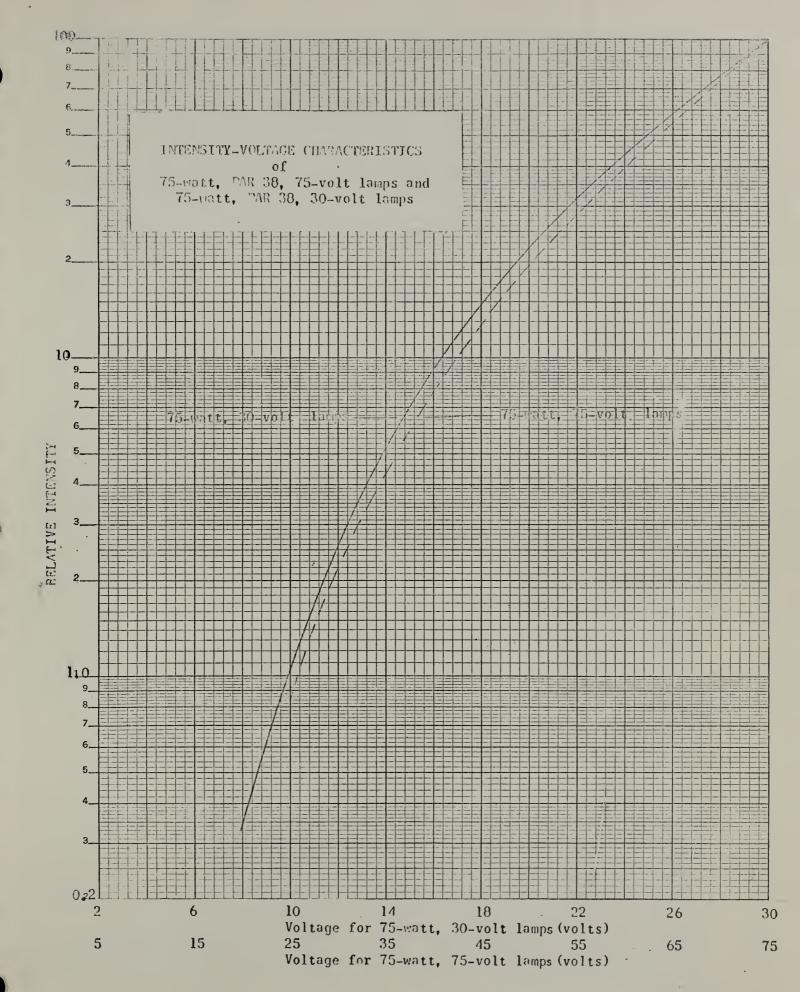
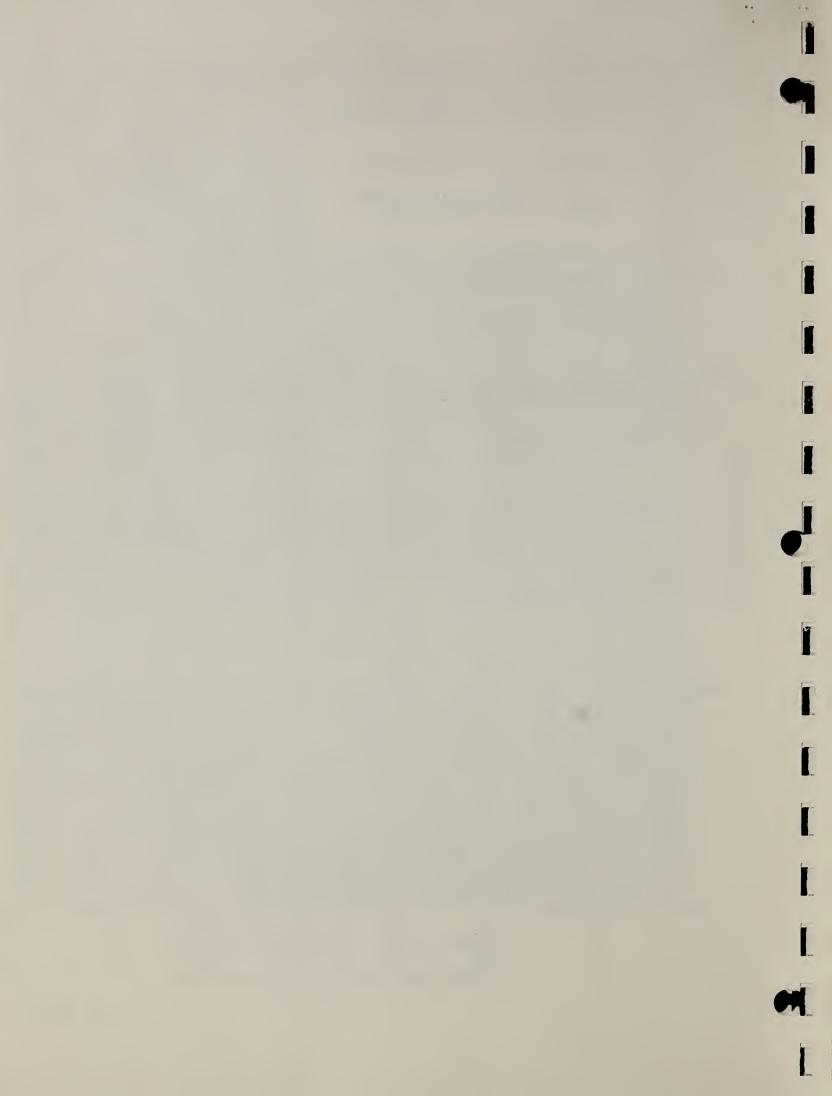
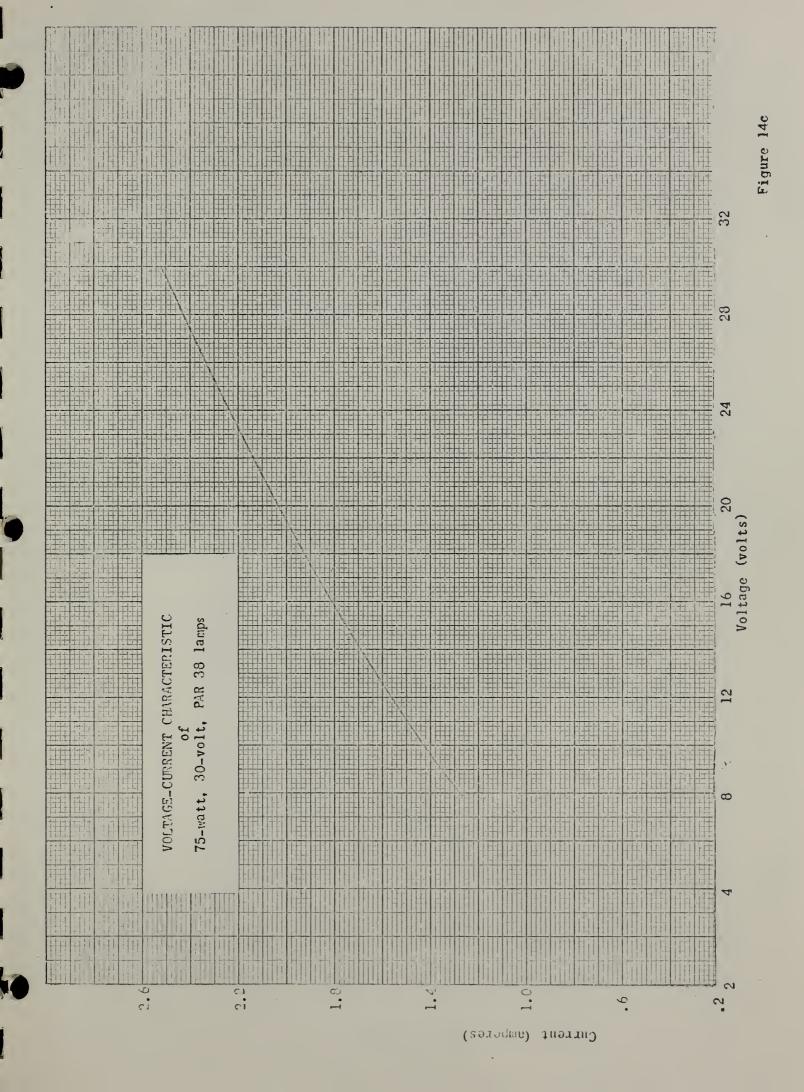
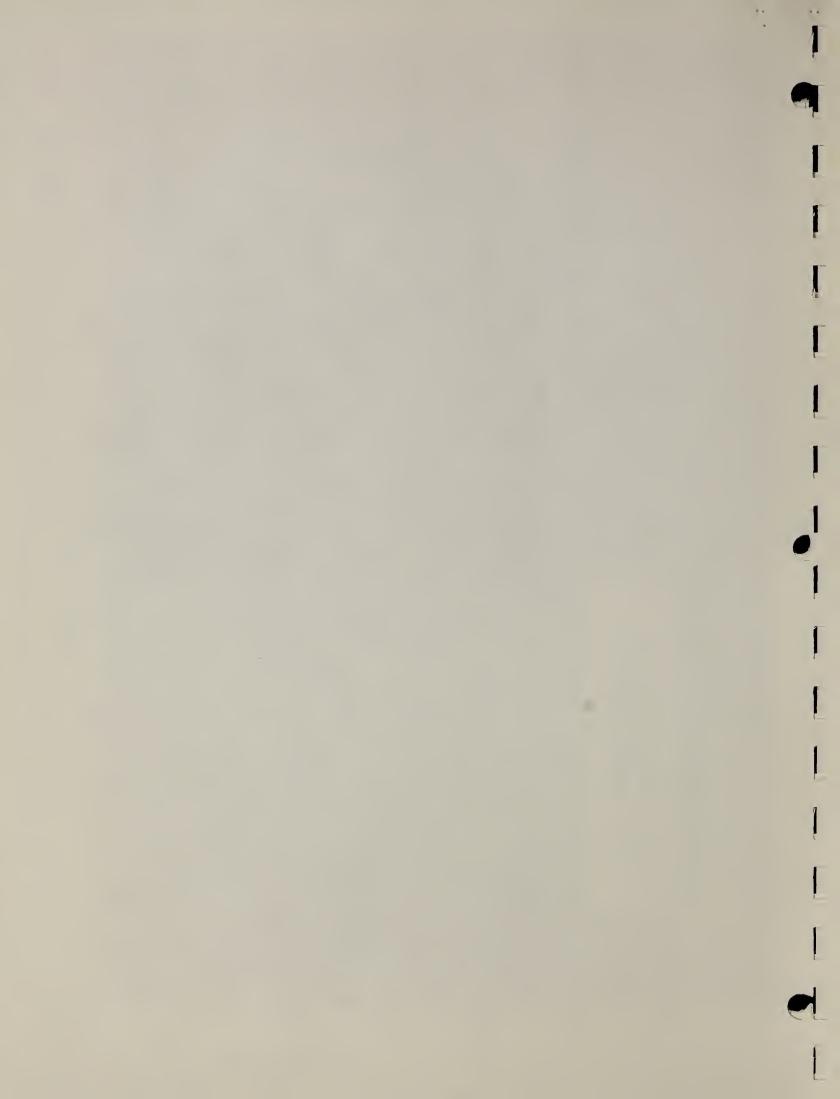
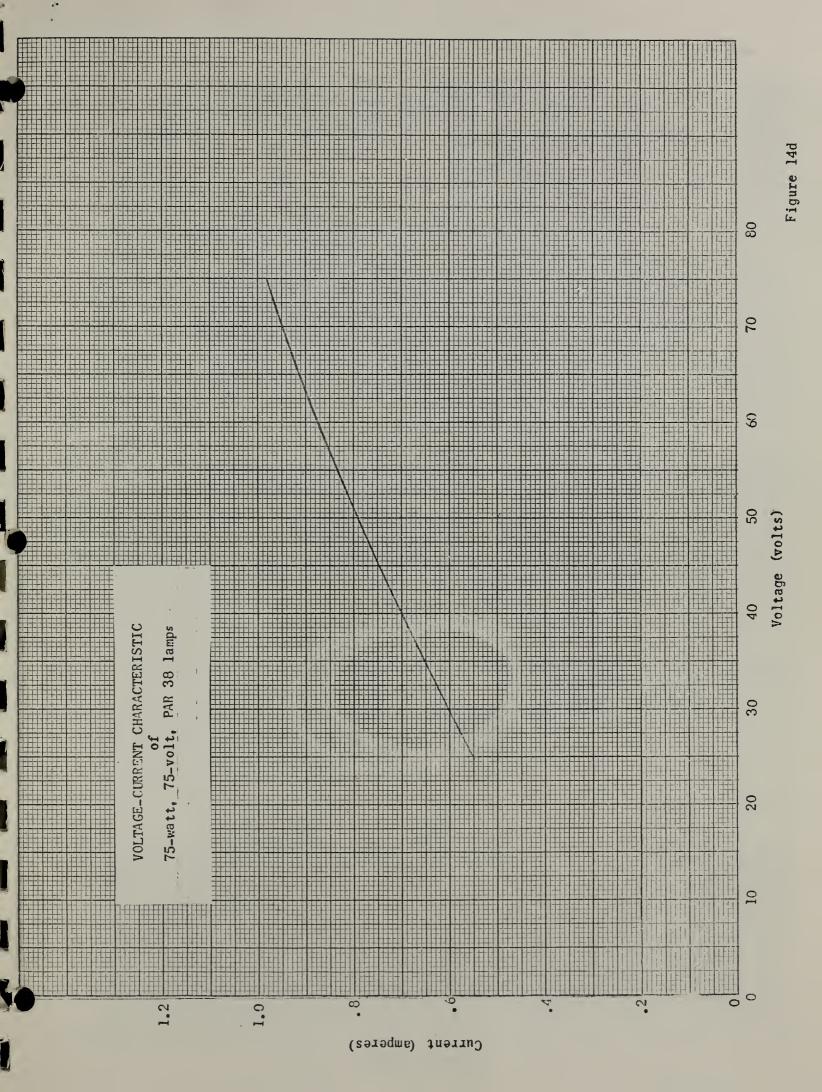


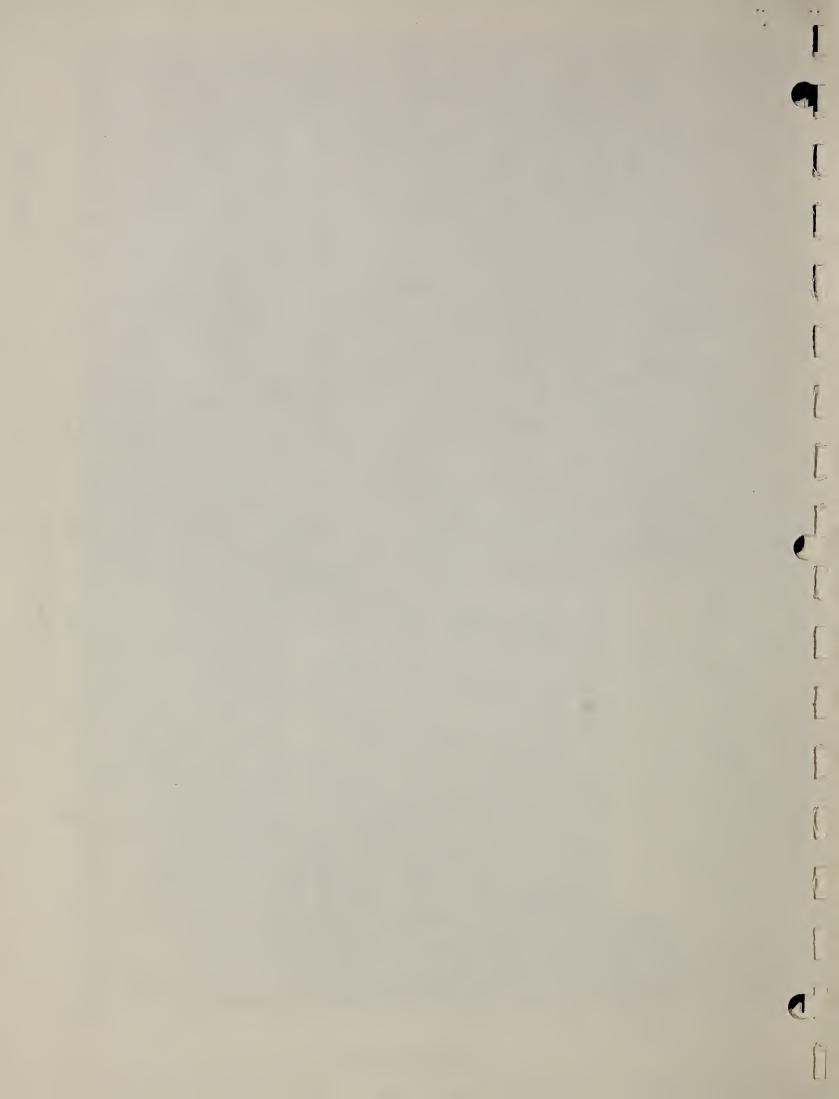
Figure 14b

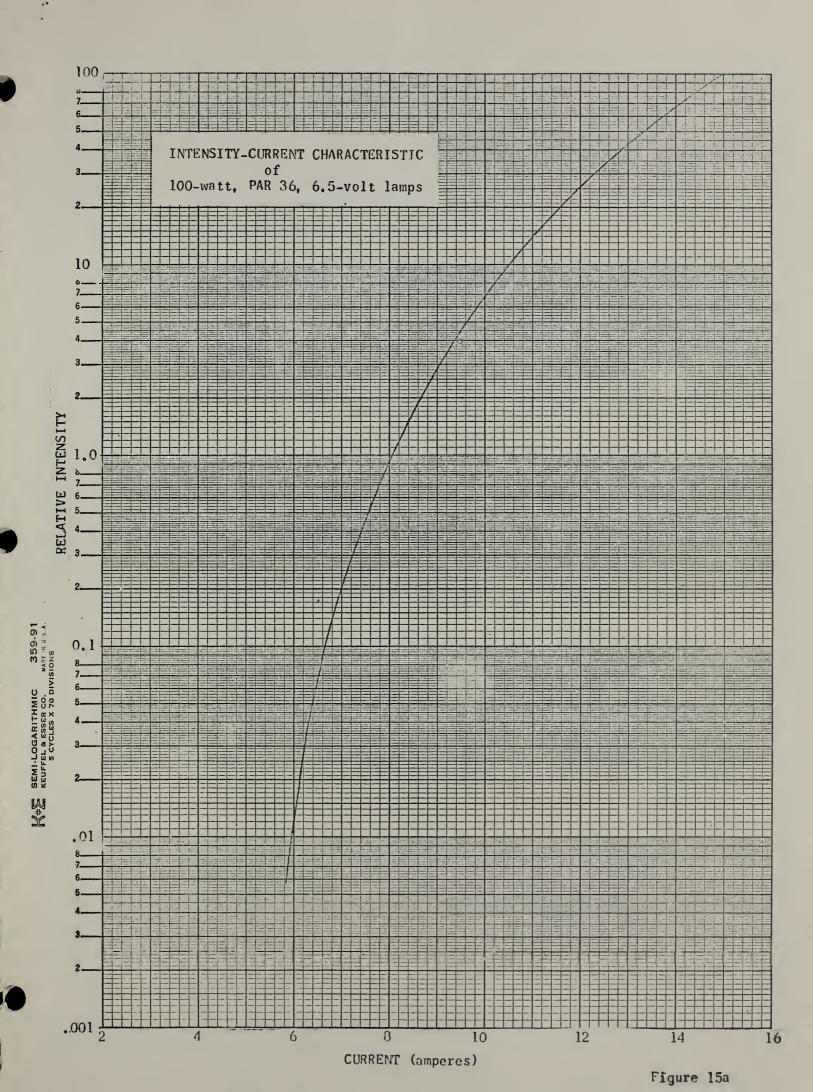


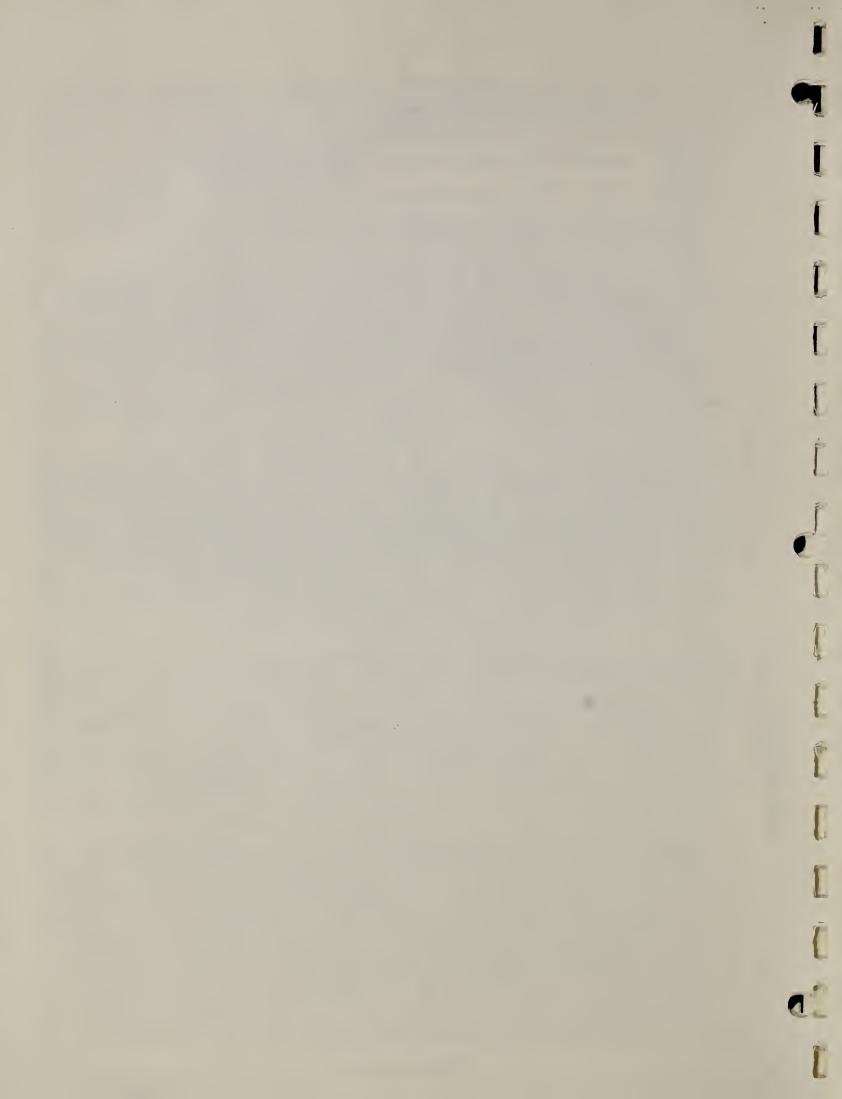


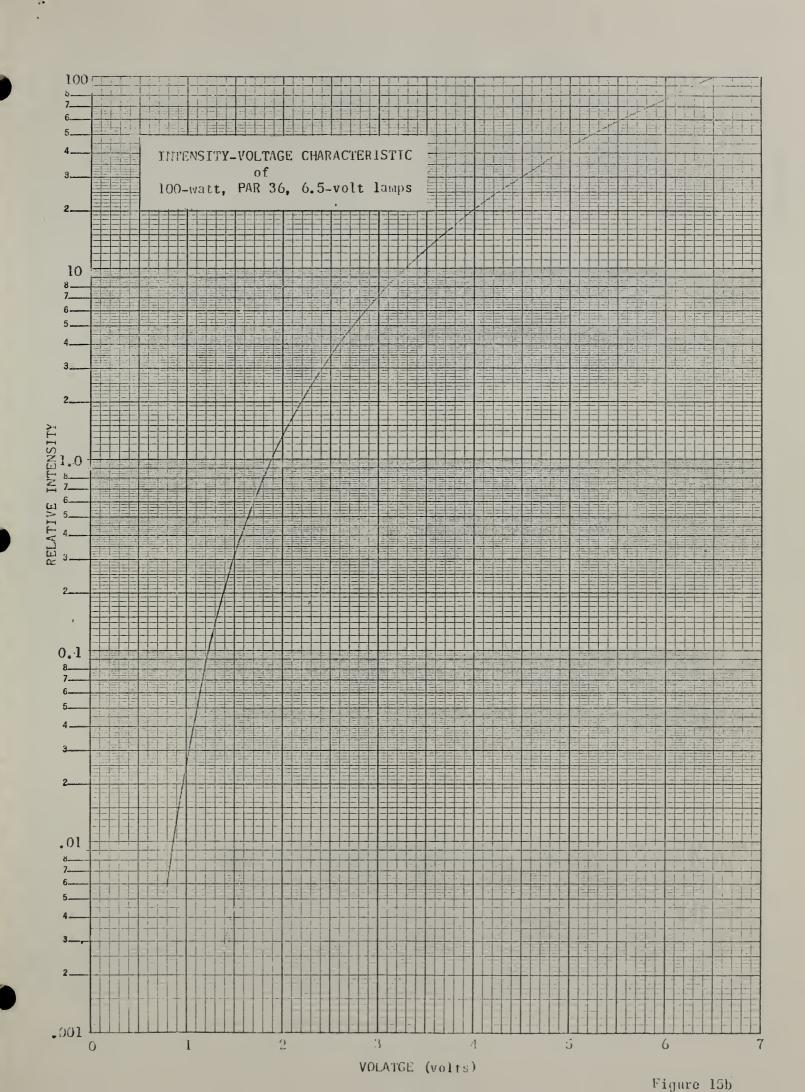


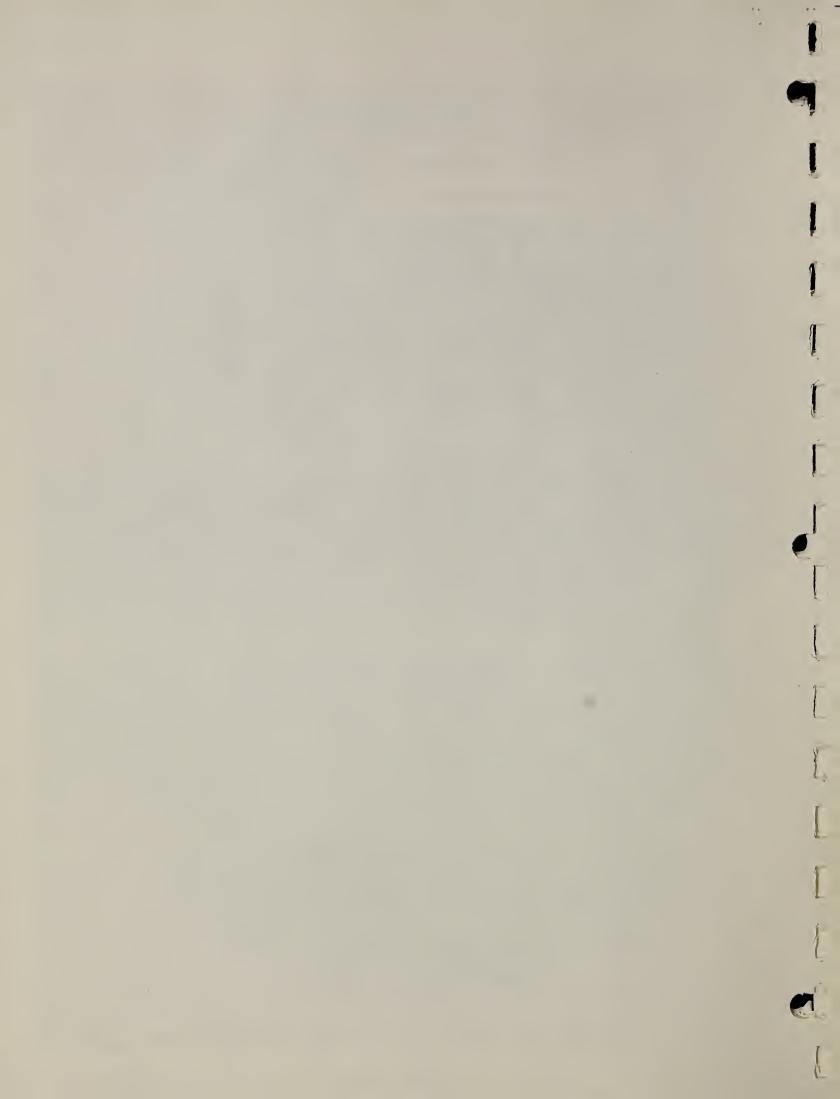


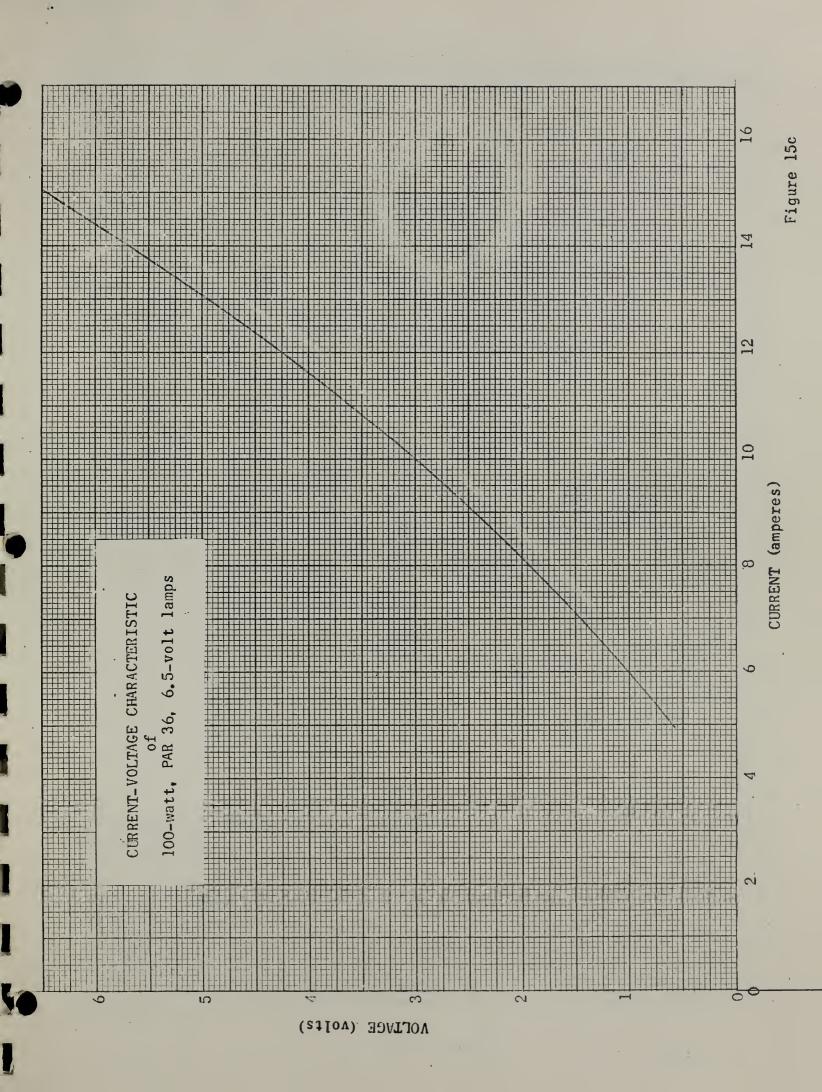


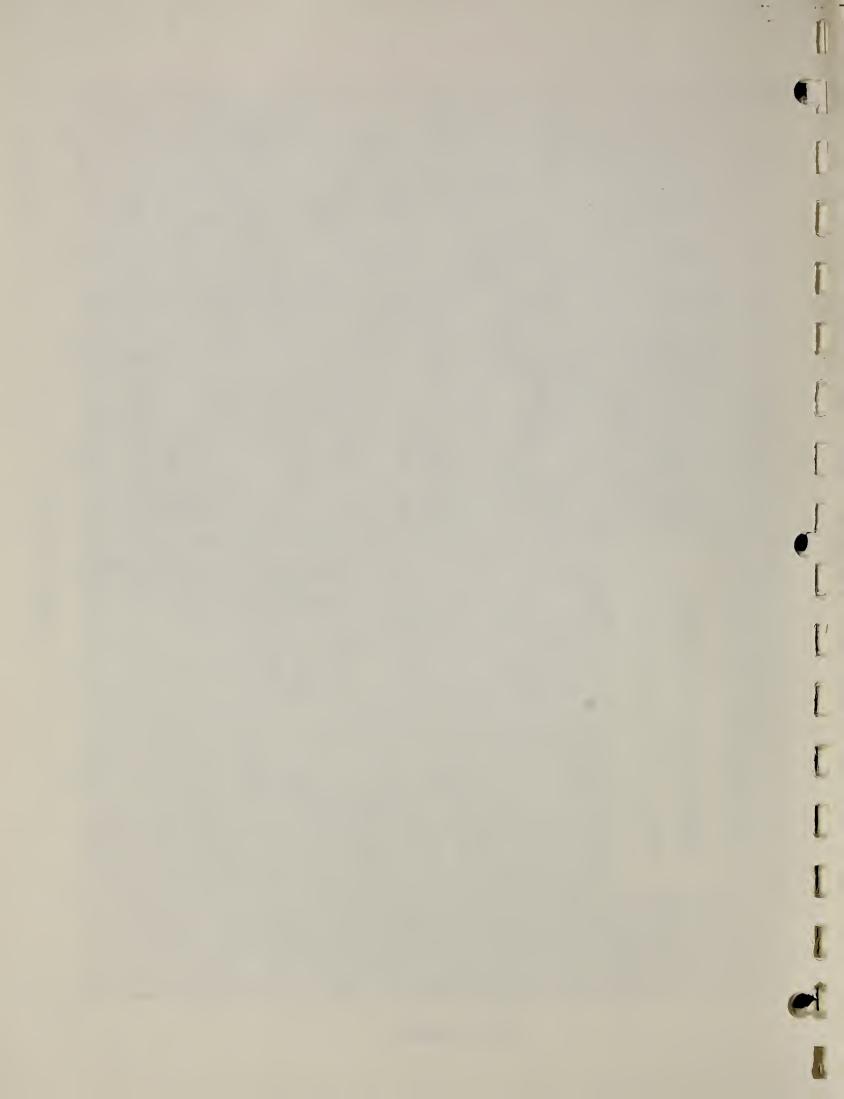


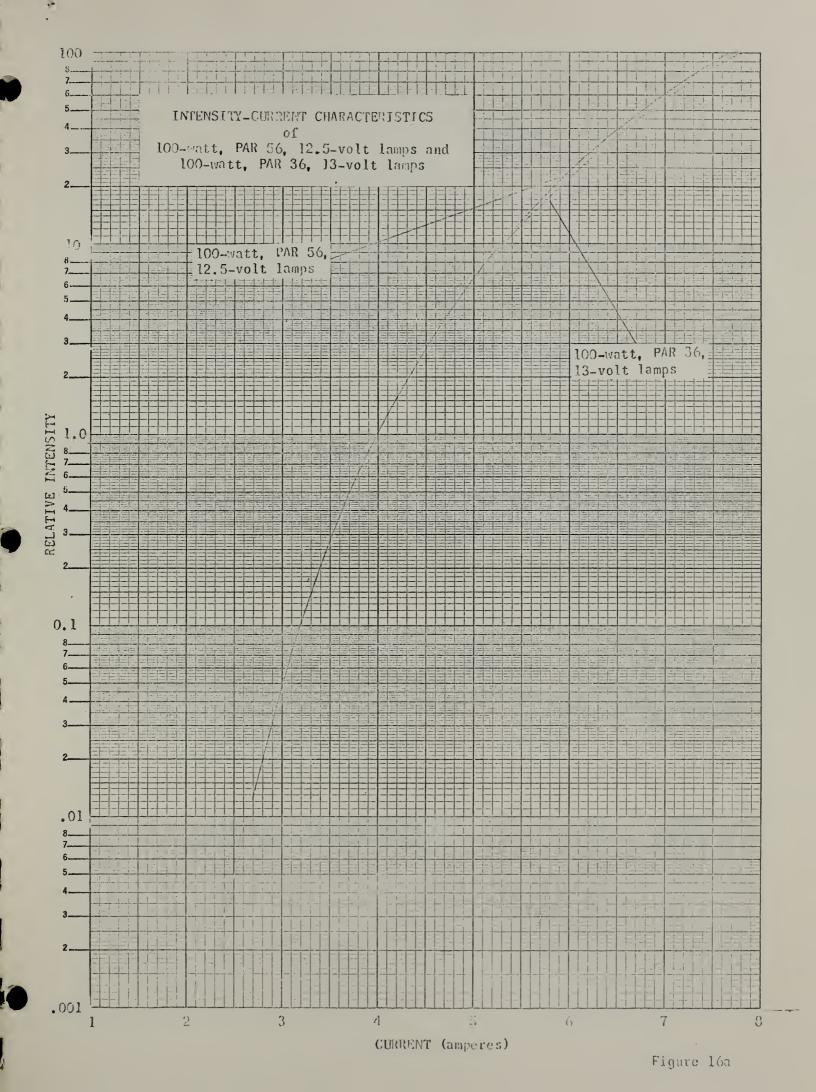


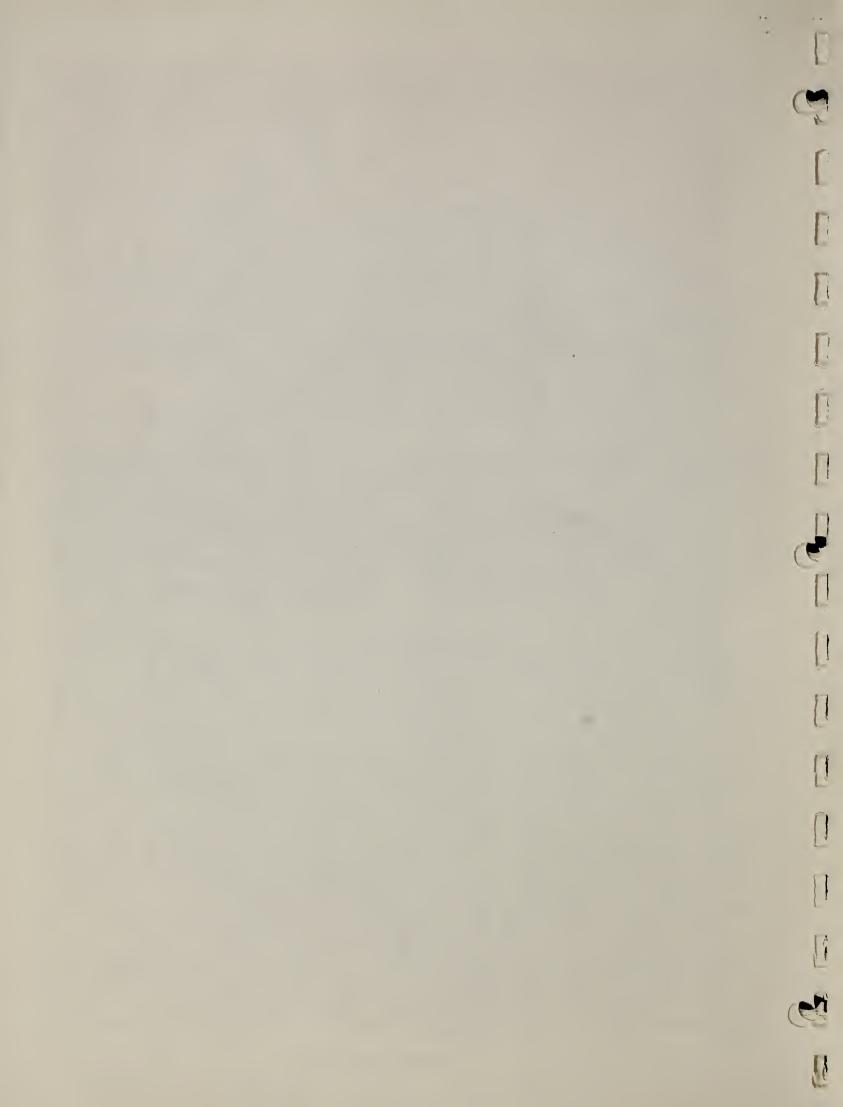


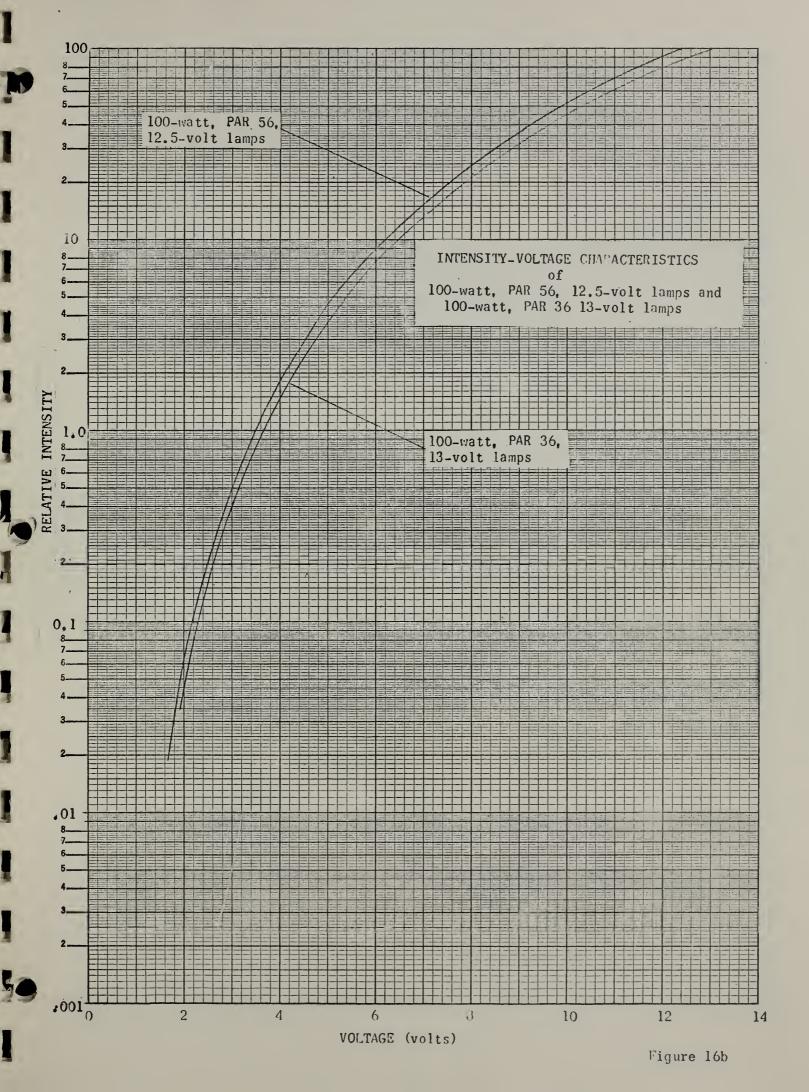


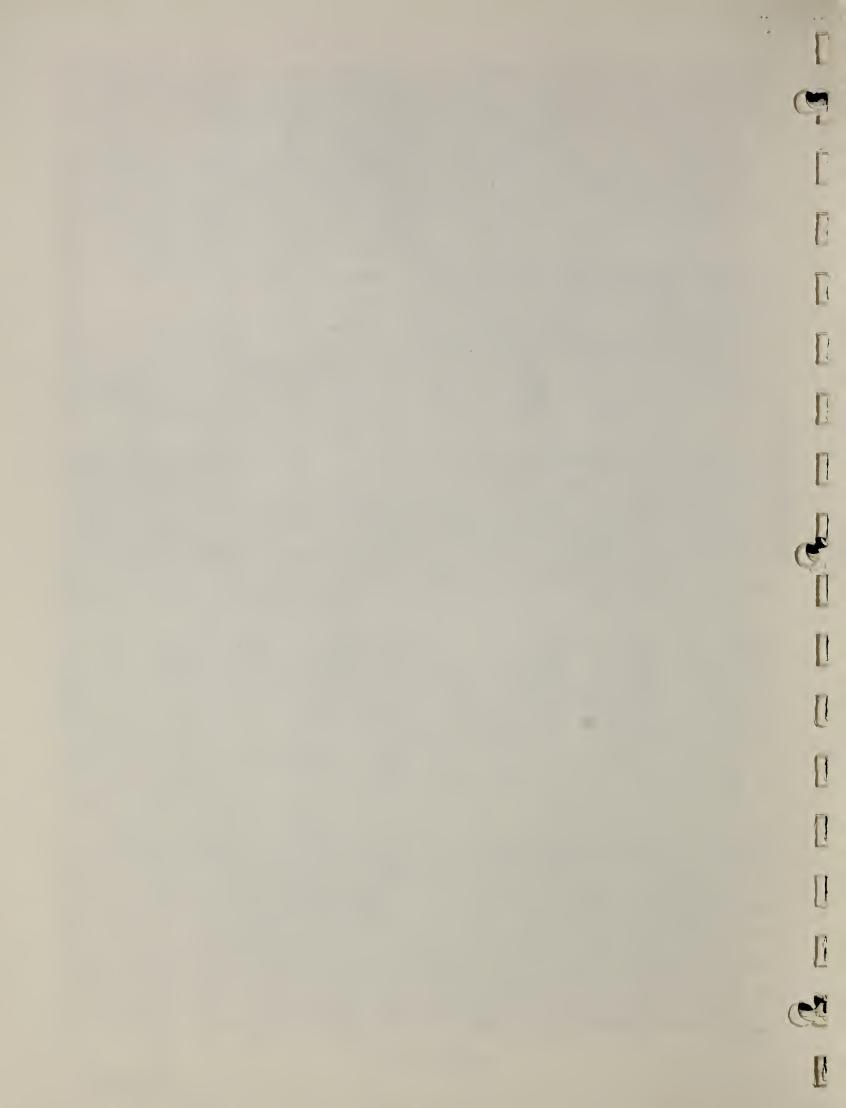


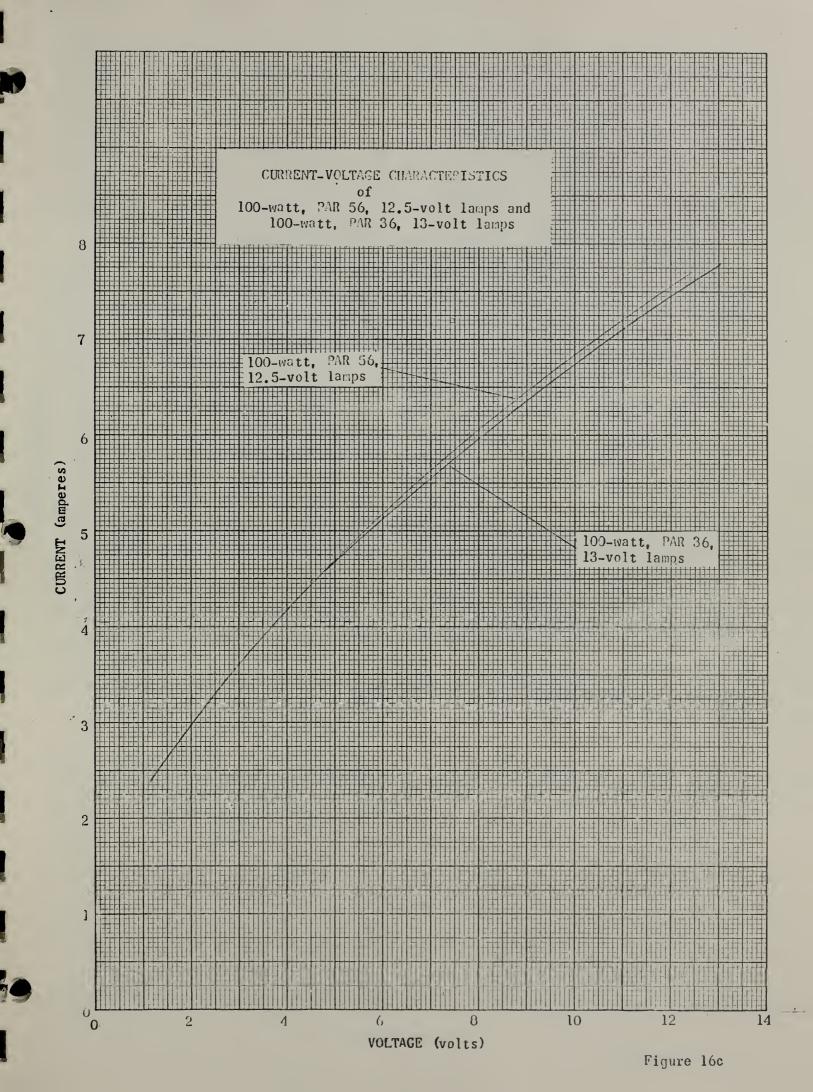


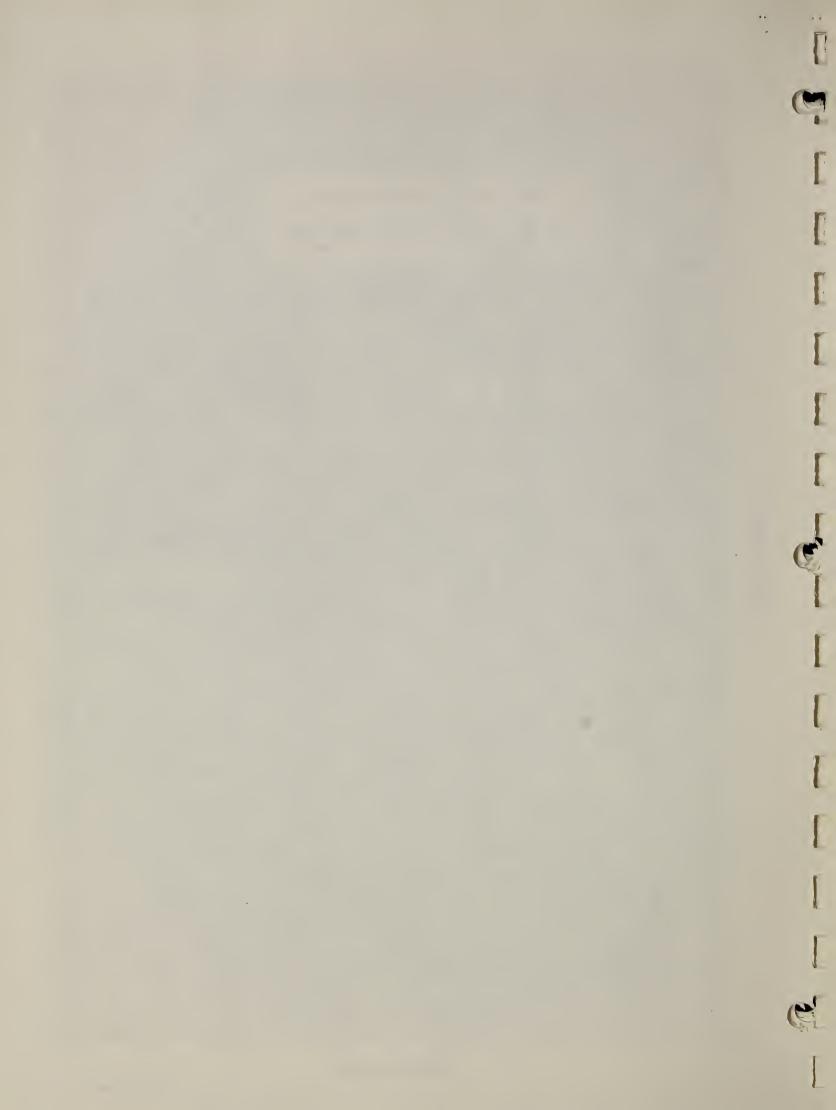


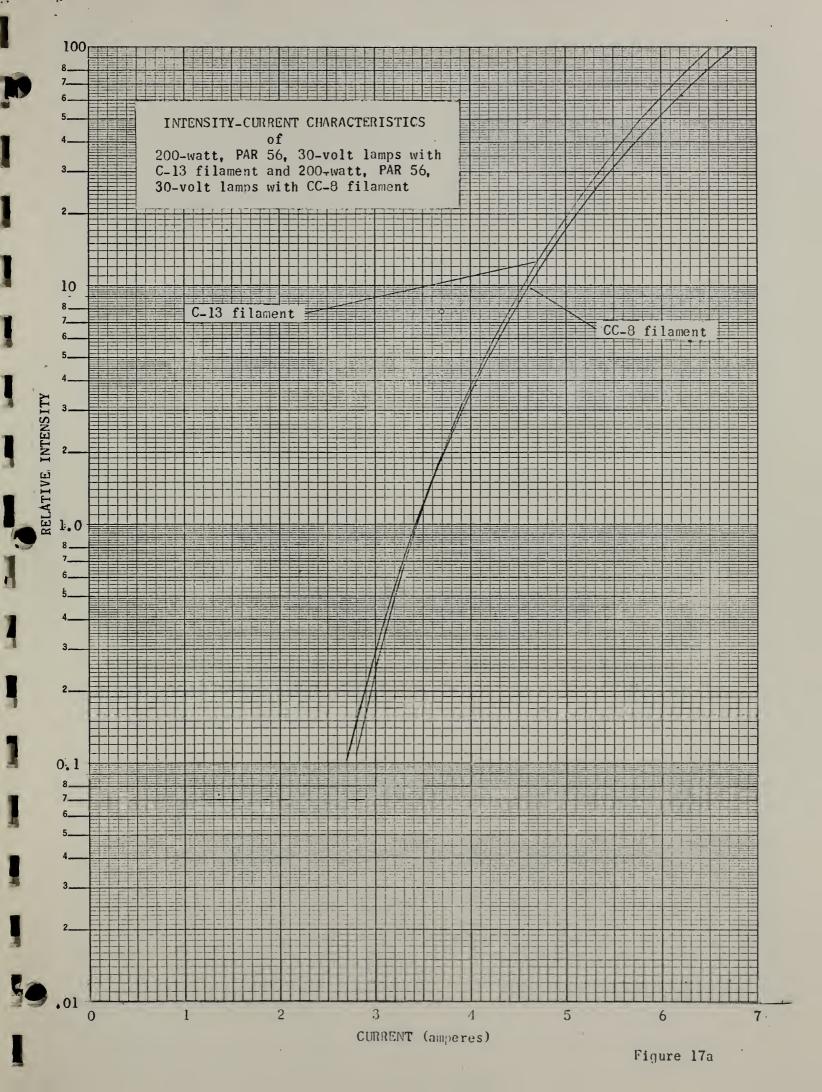


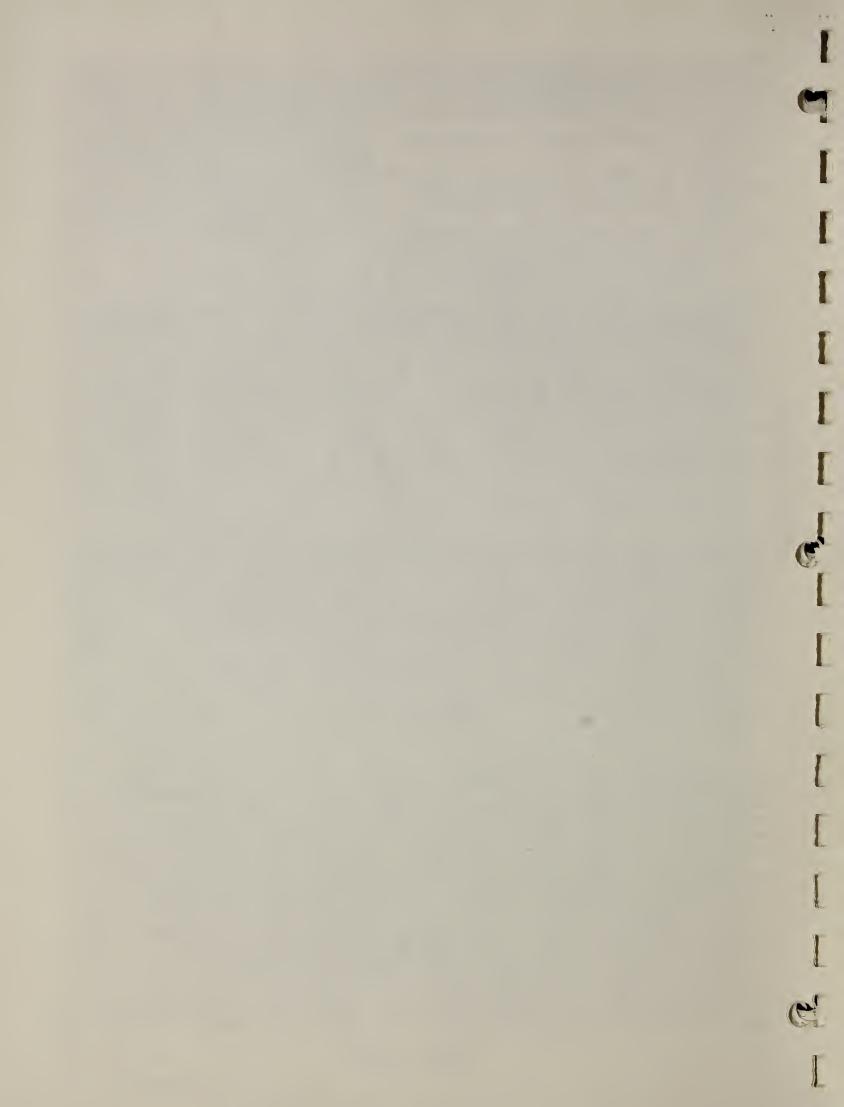


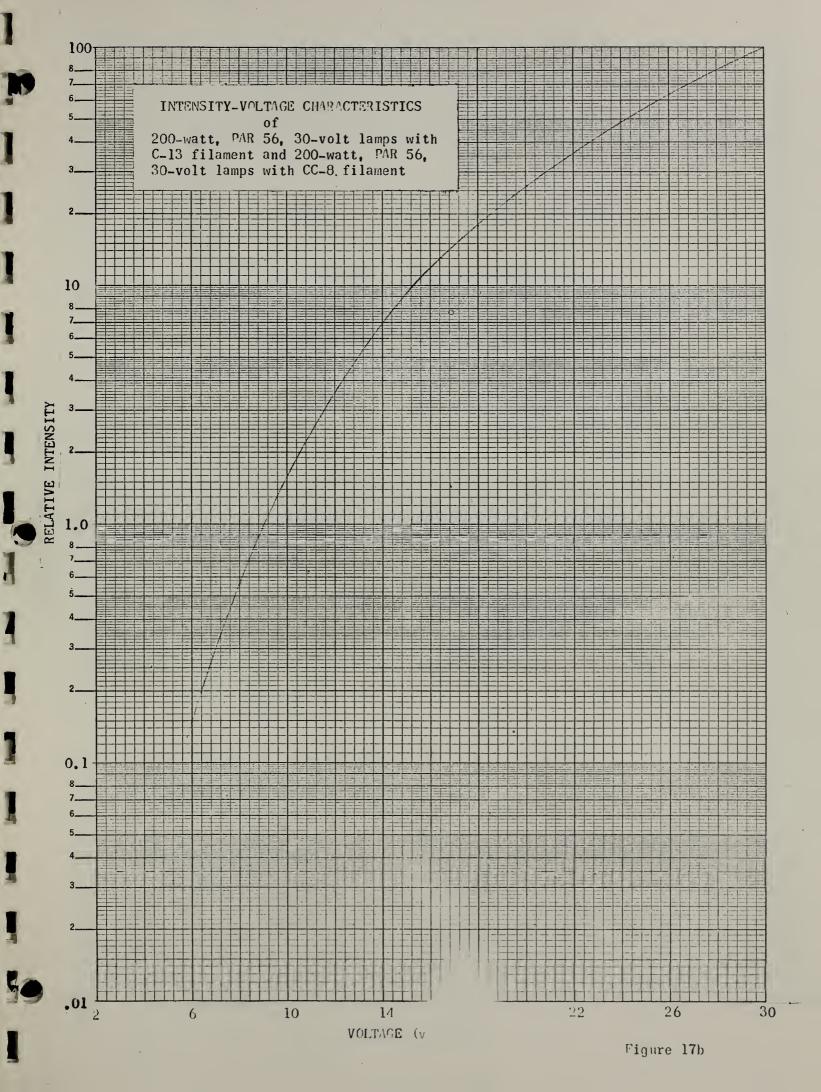


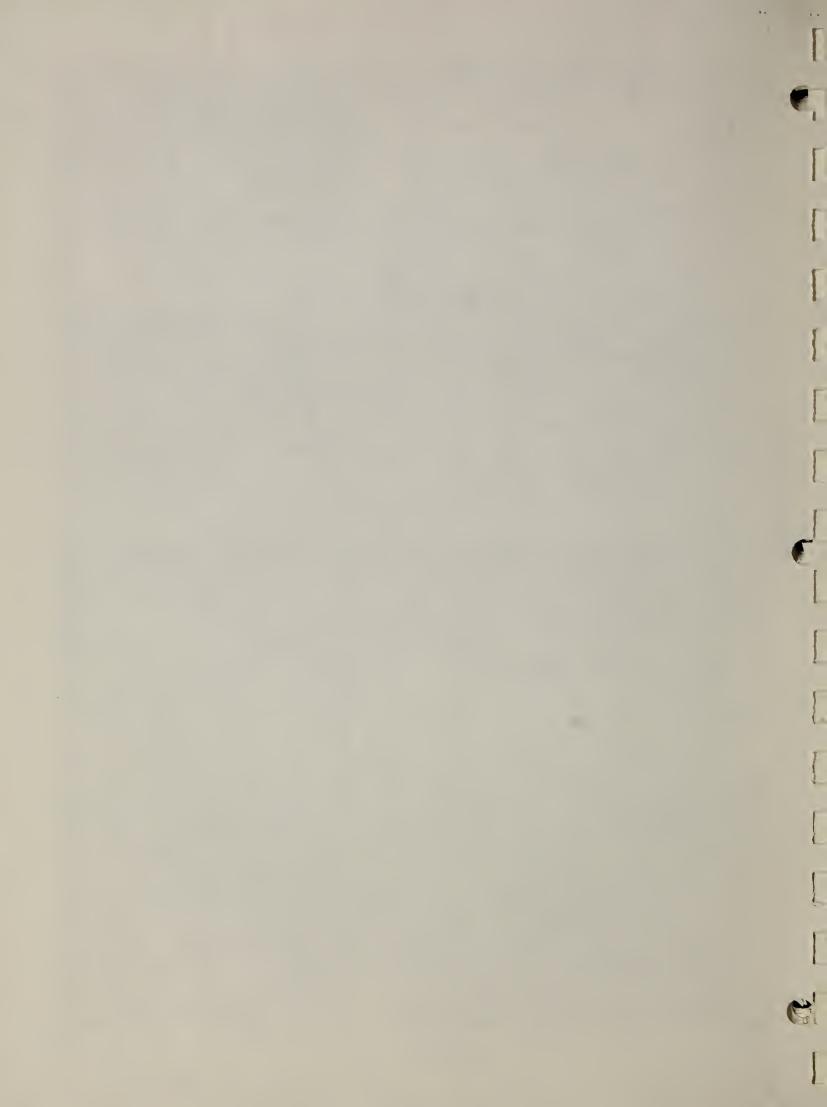


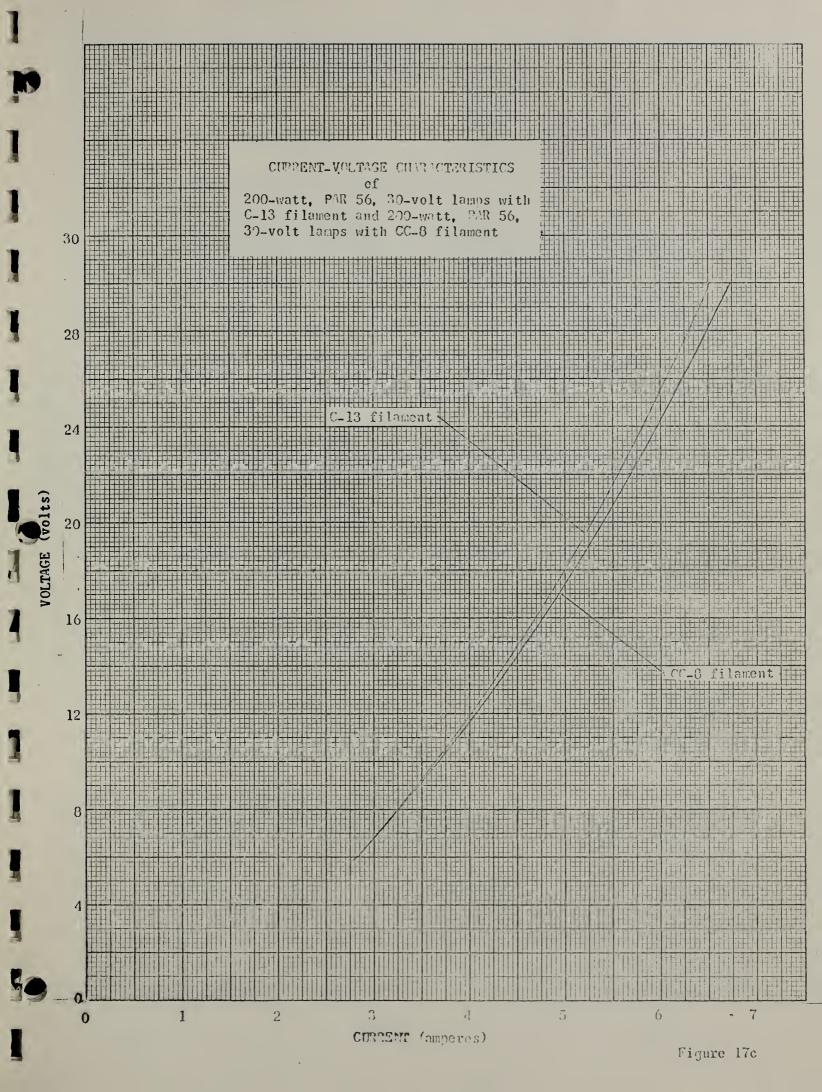


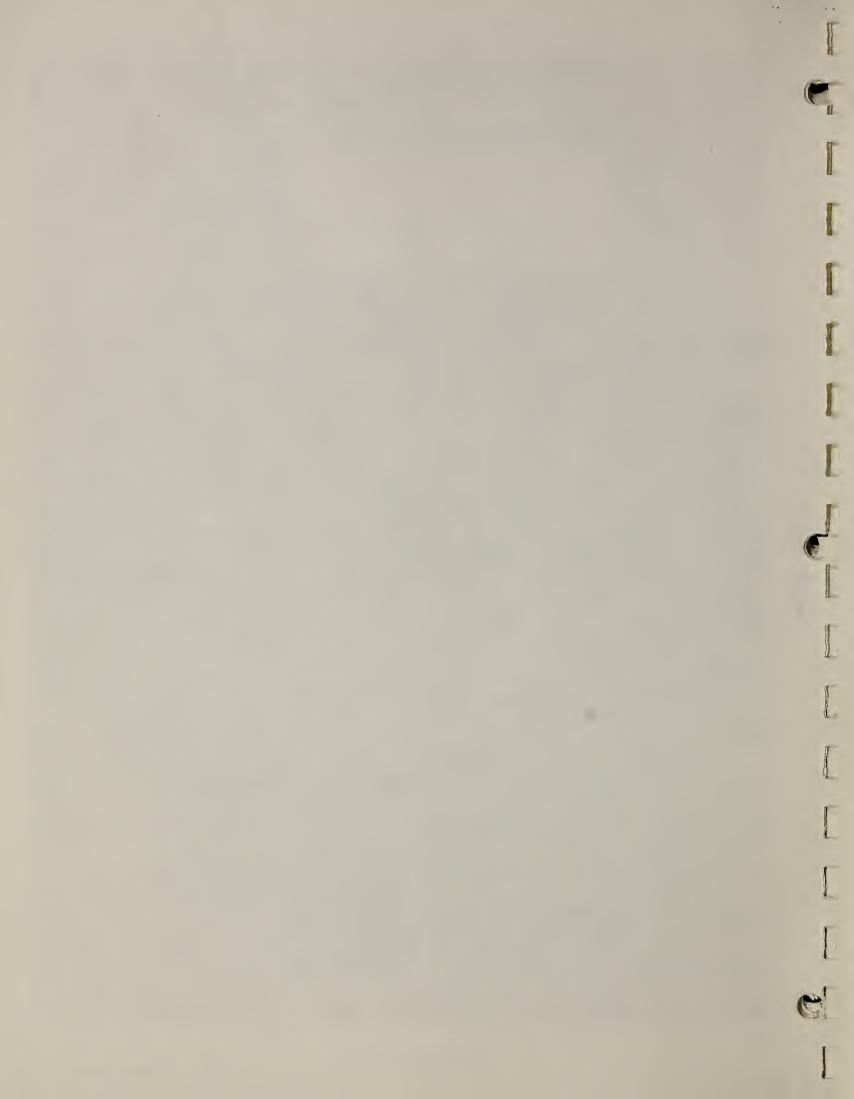


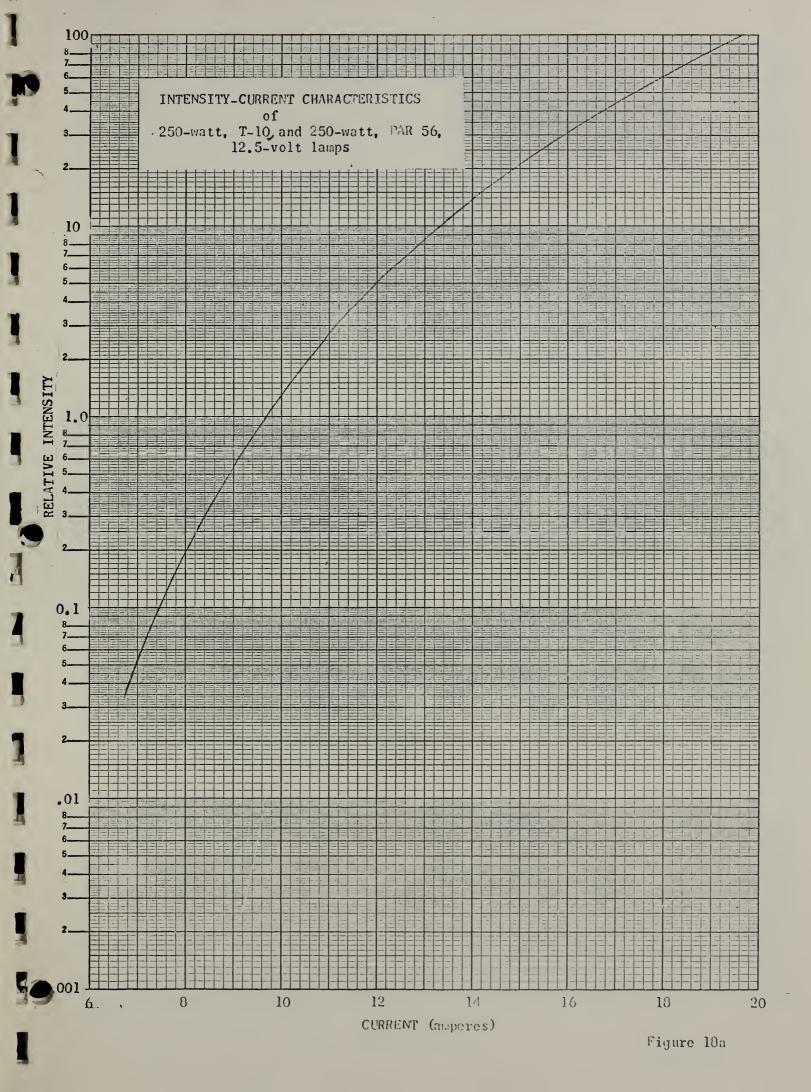


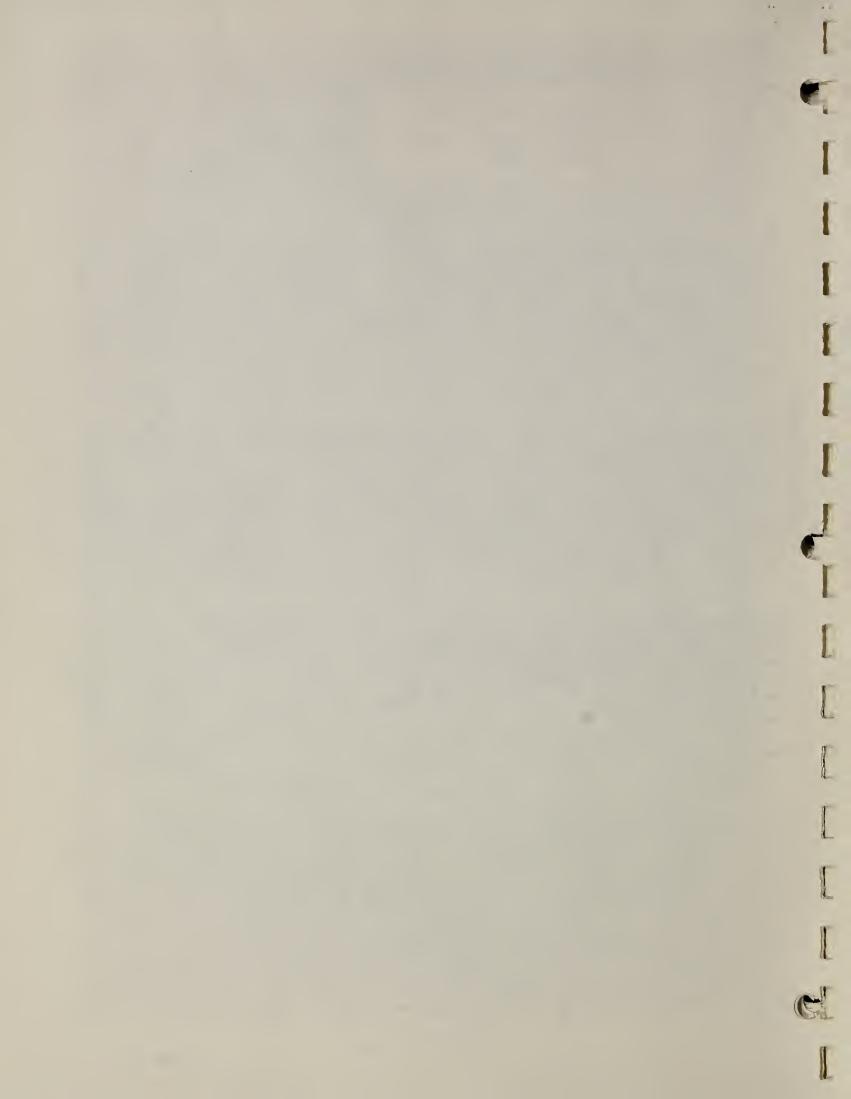


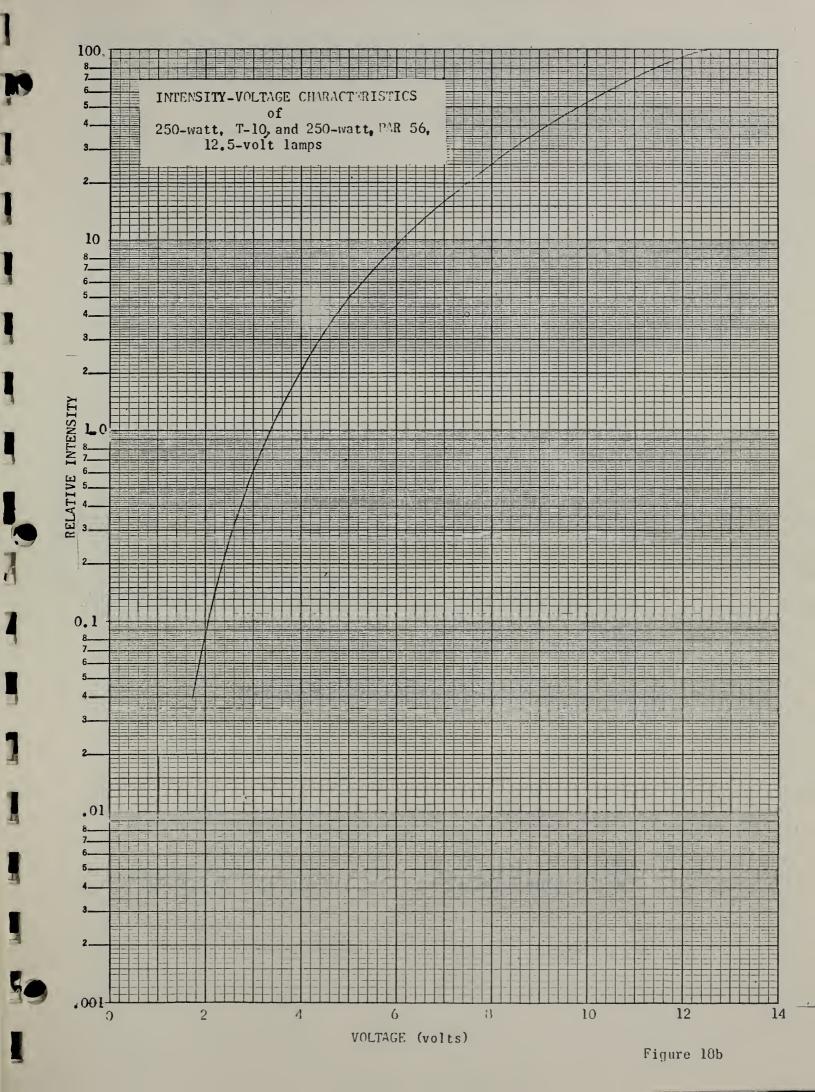


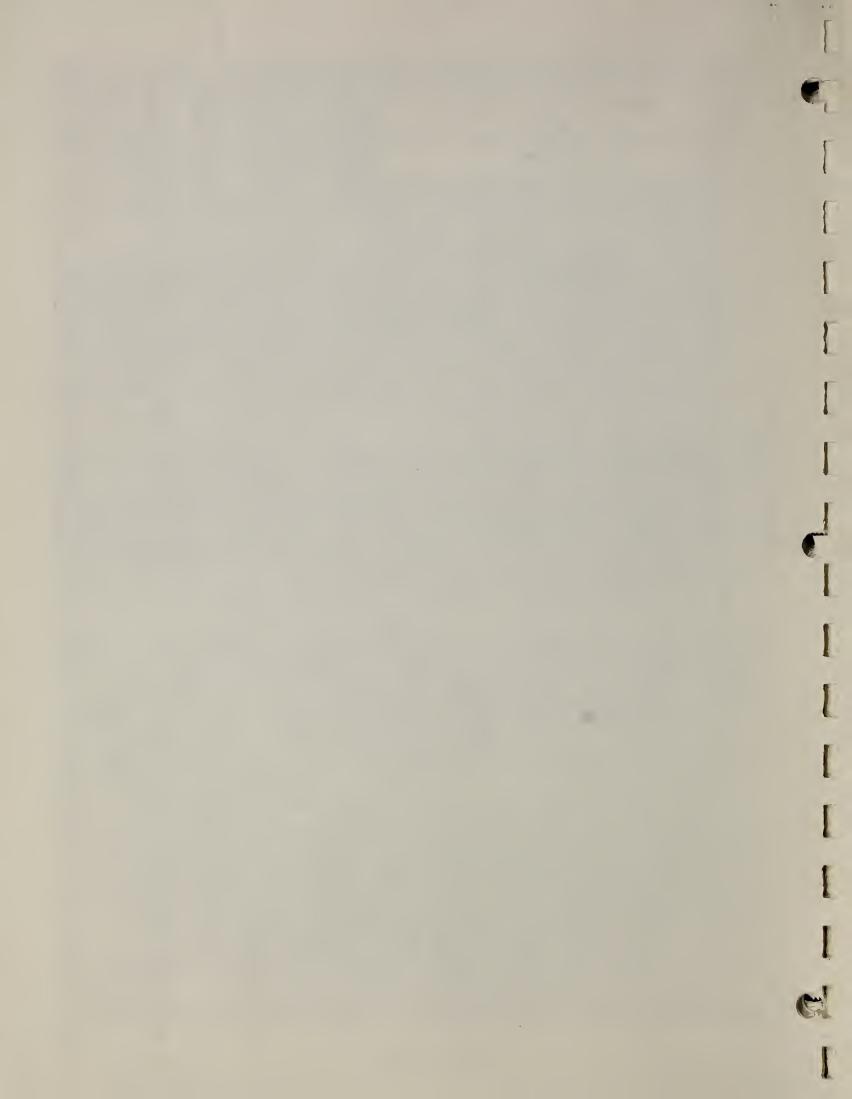


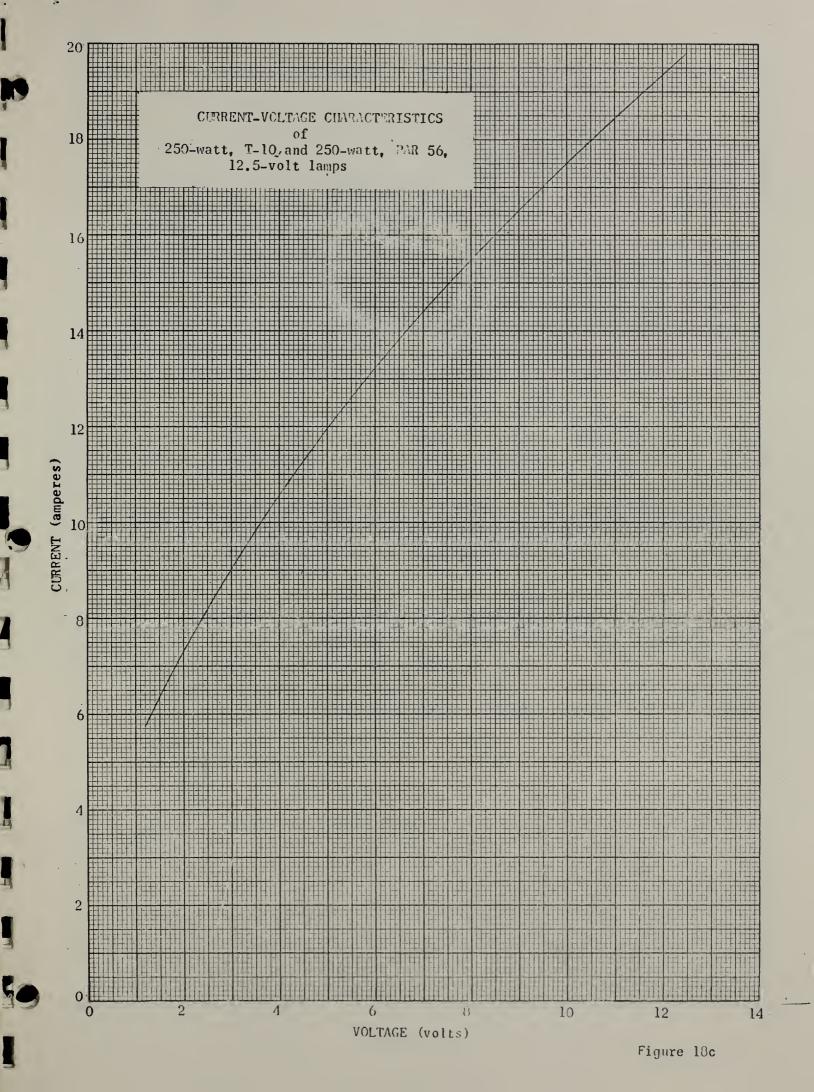


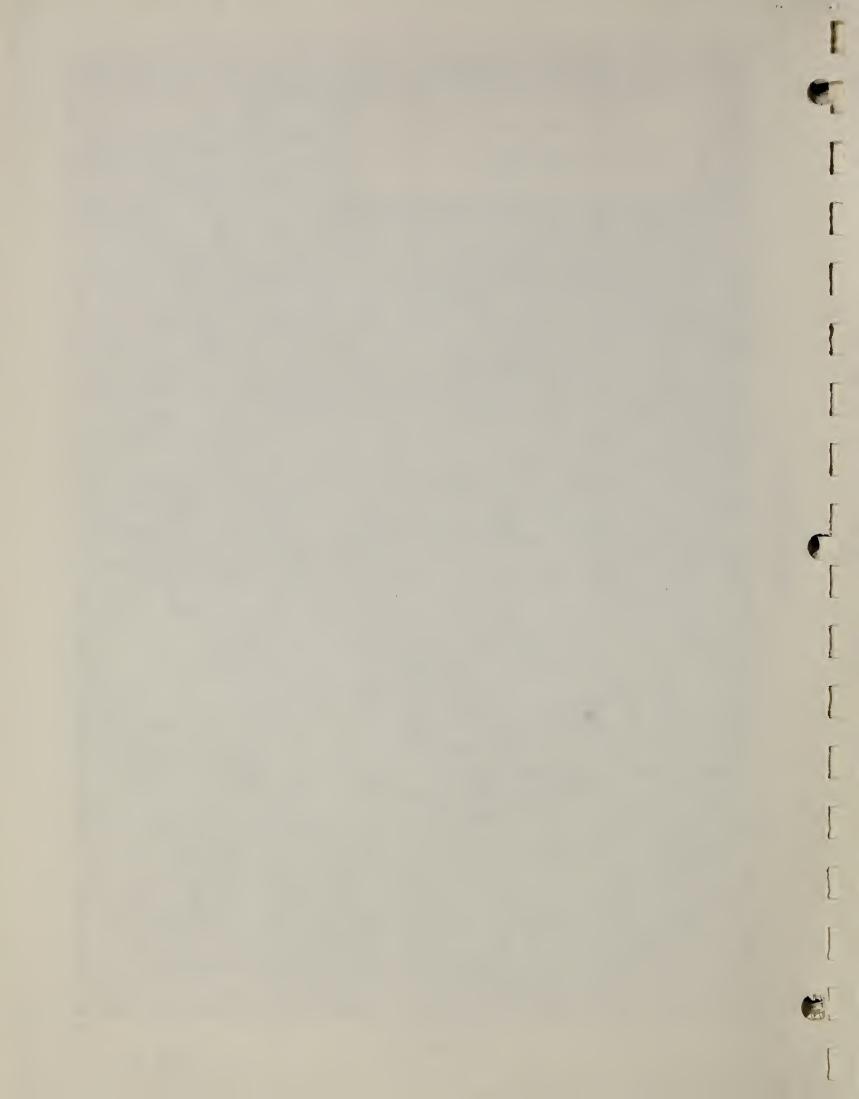


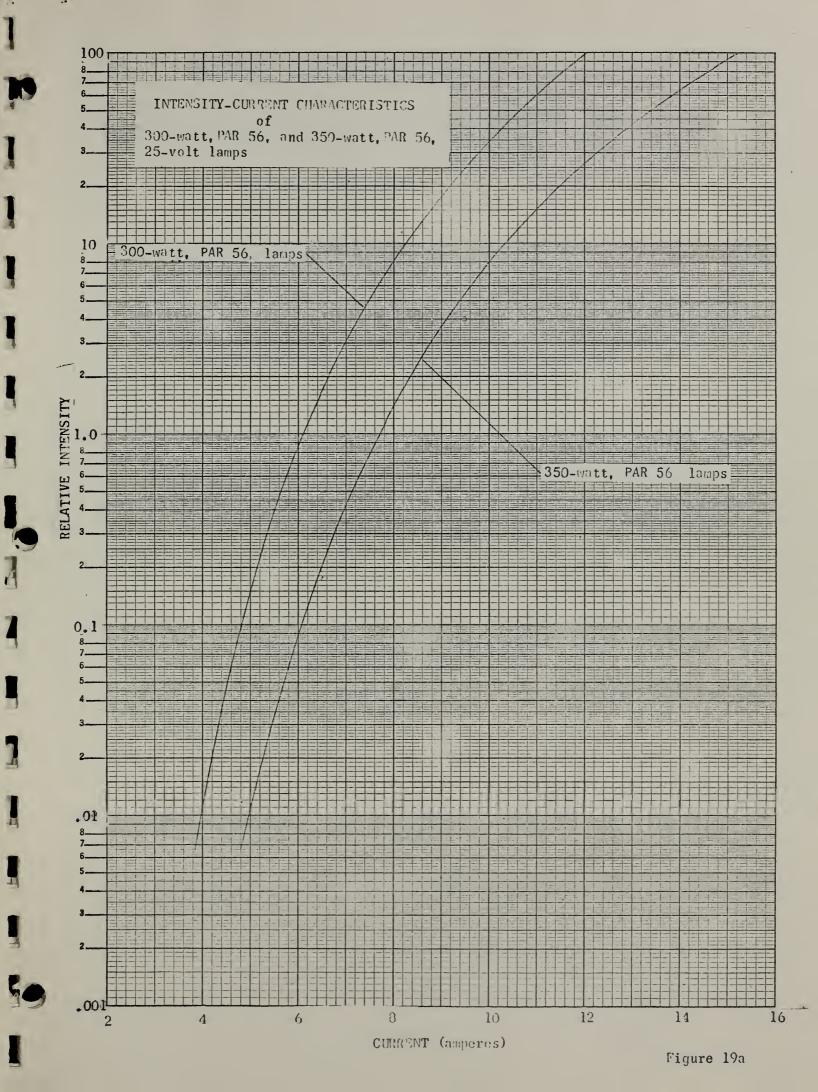


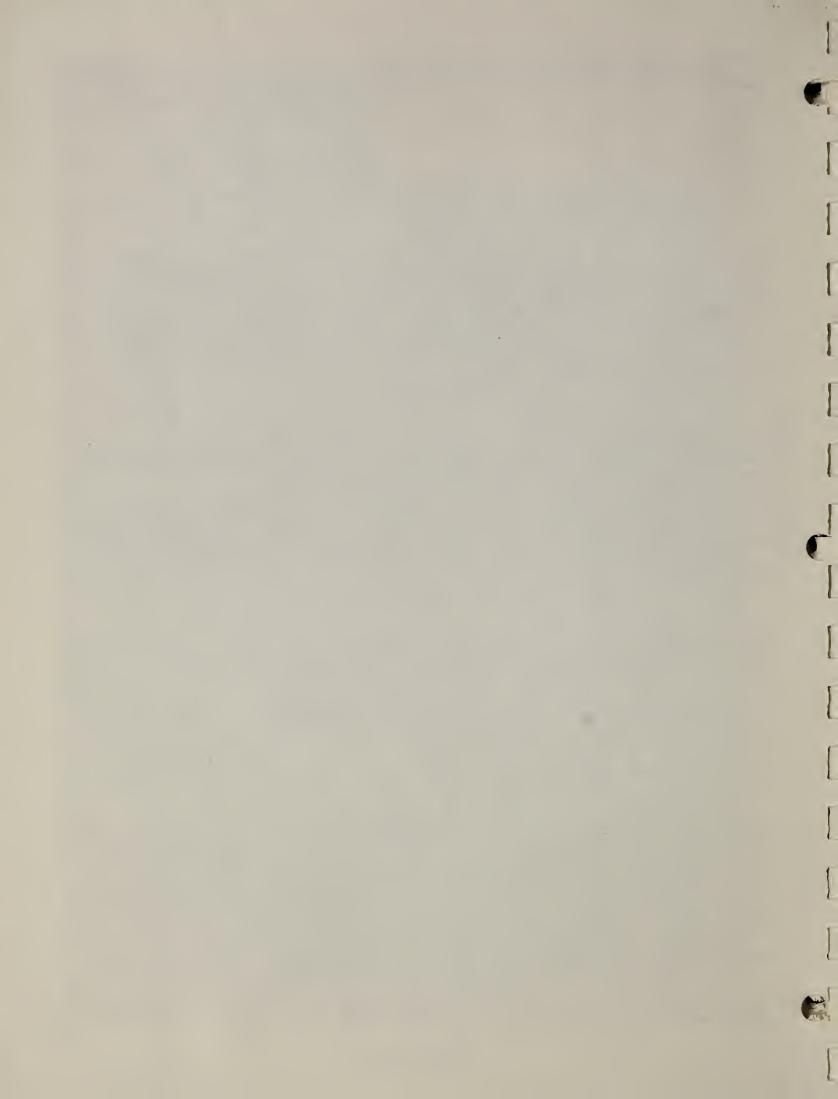


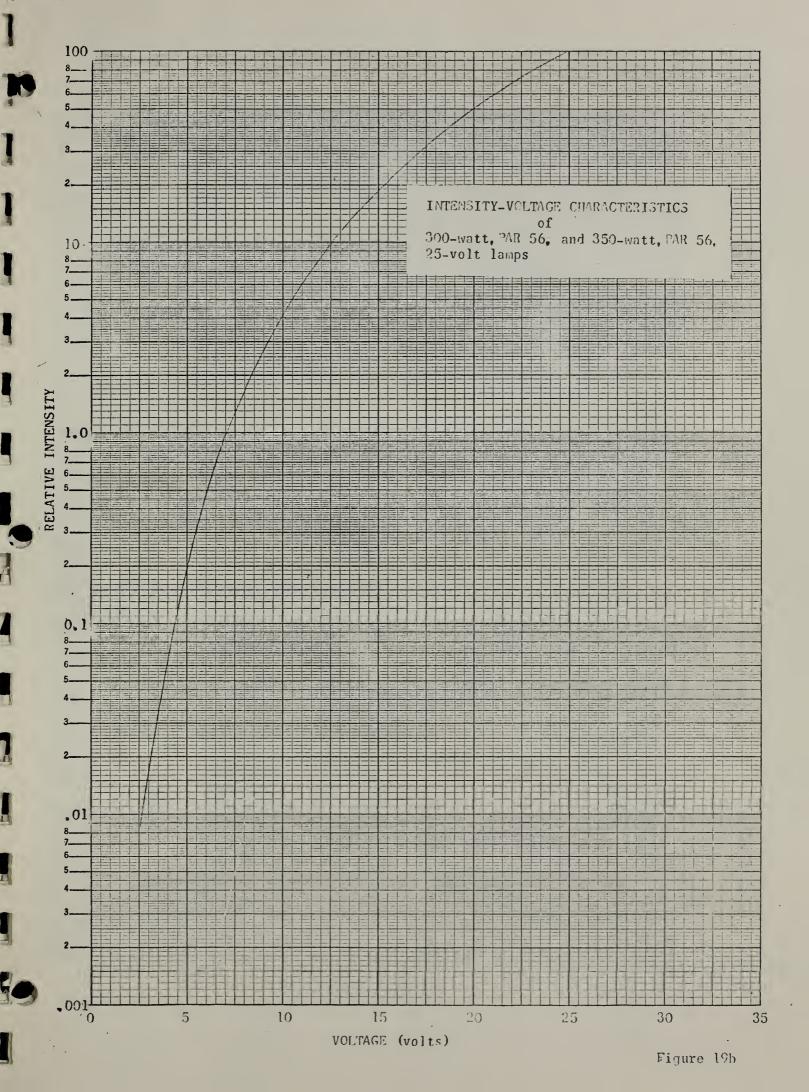


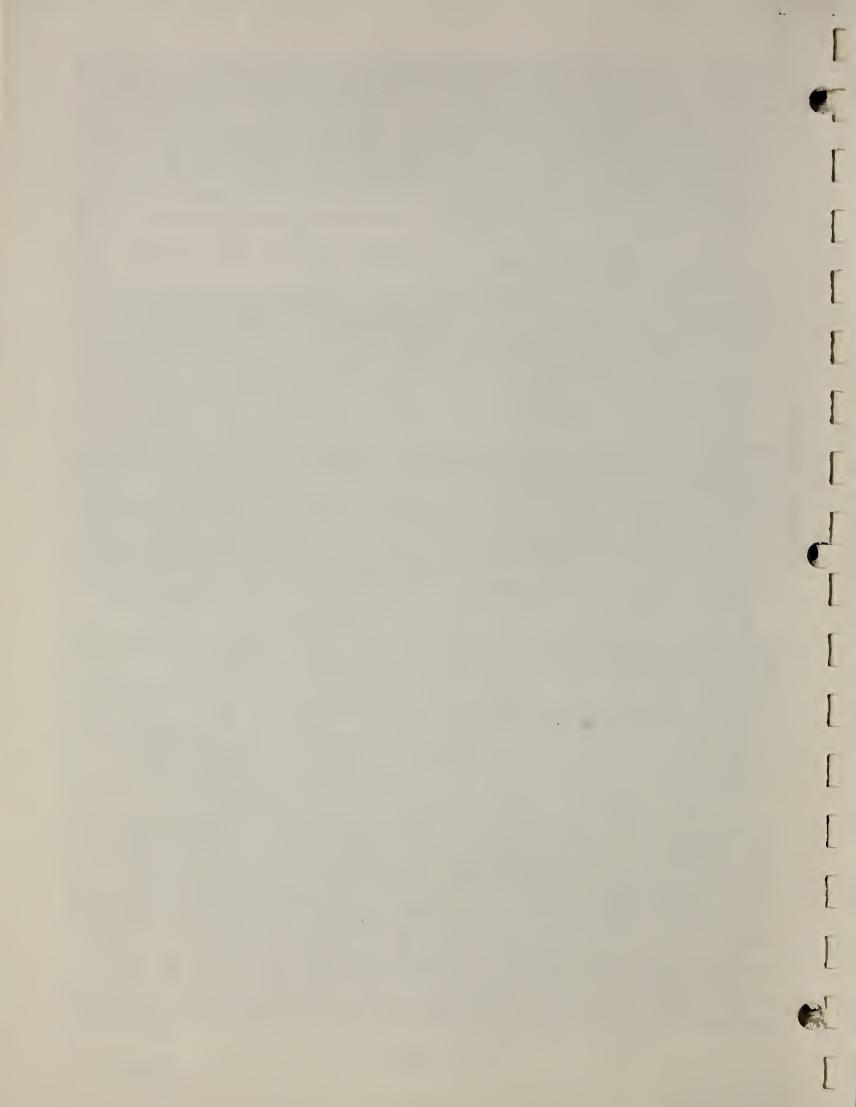


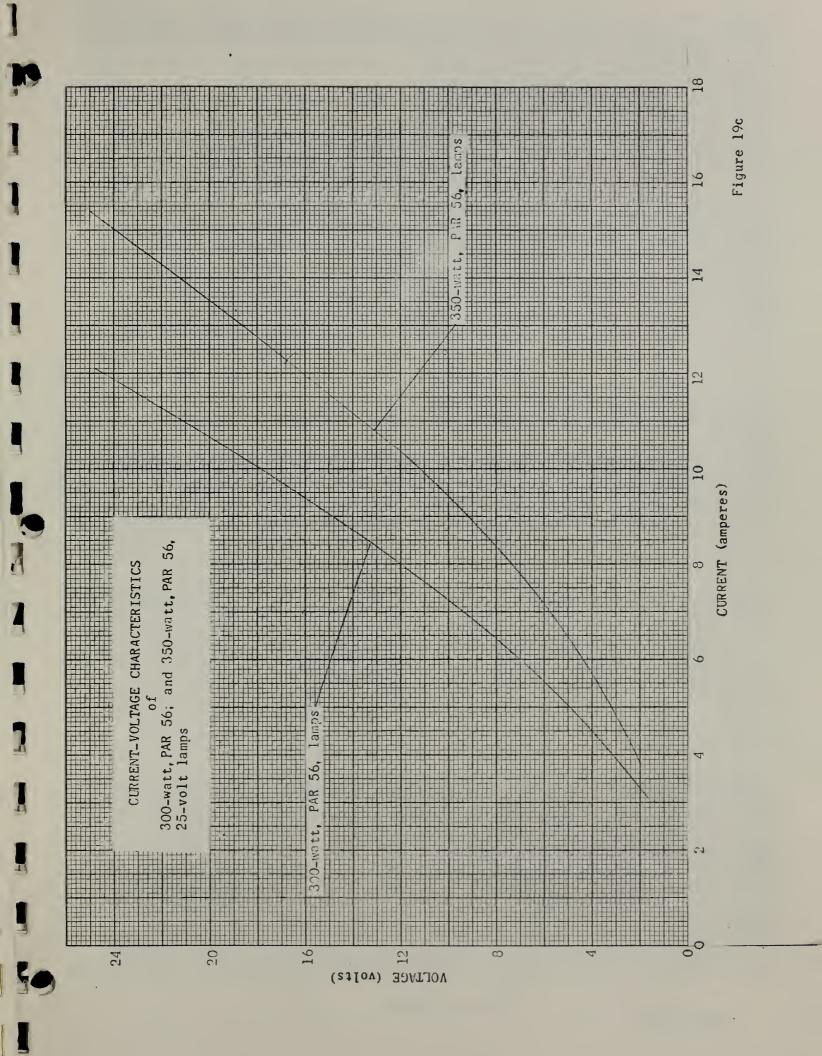


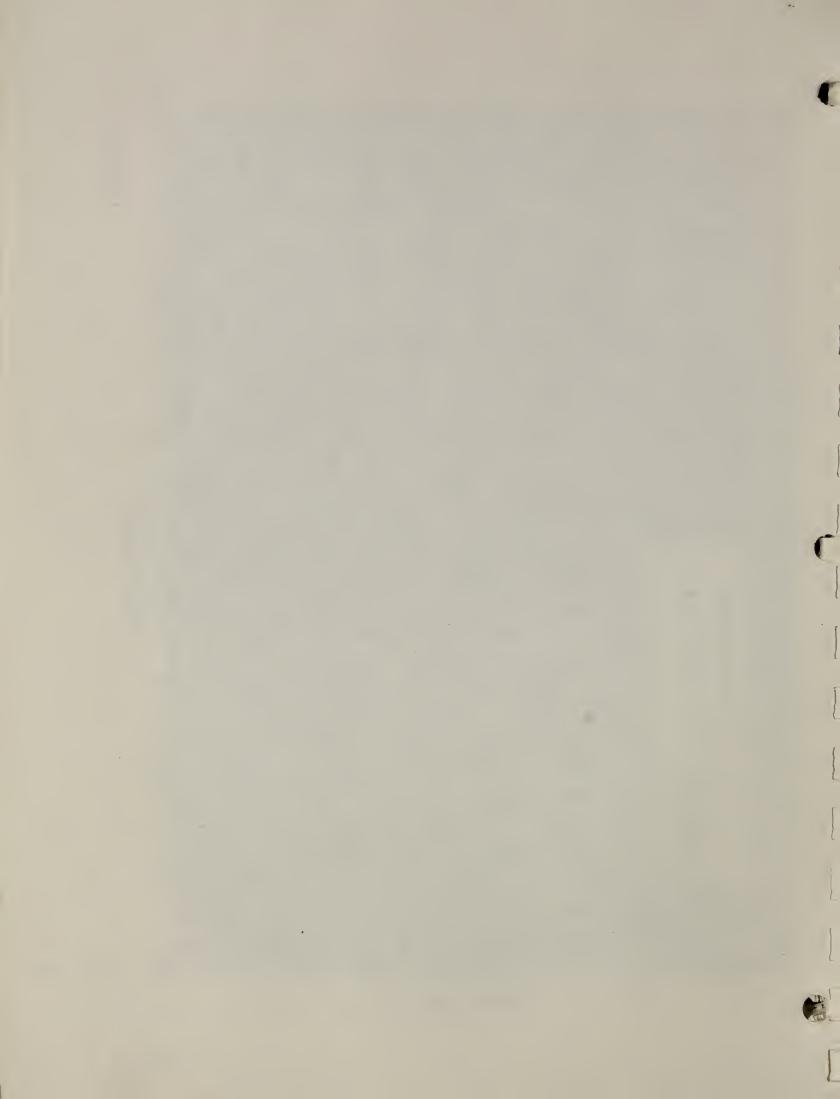


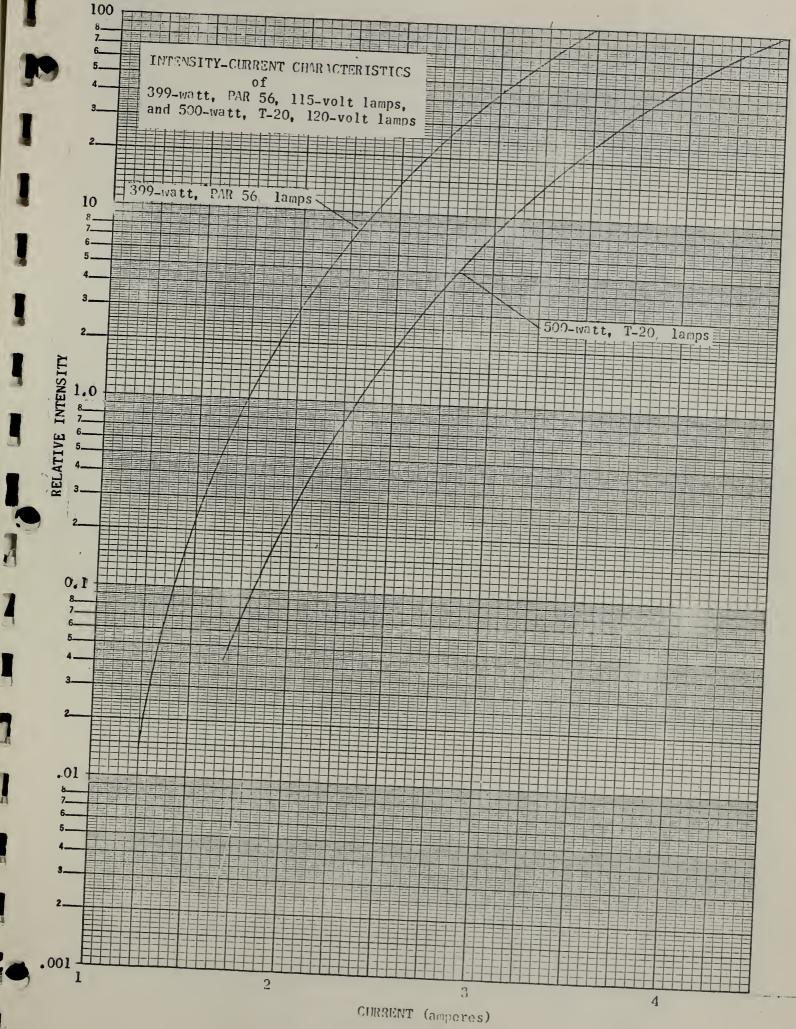


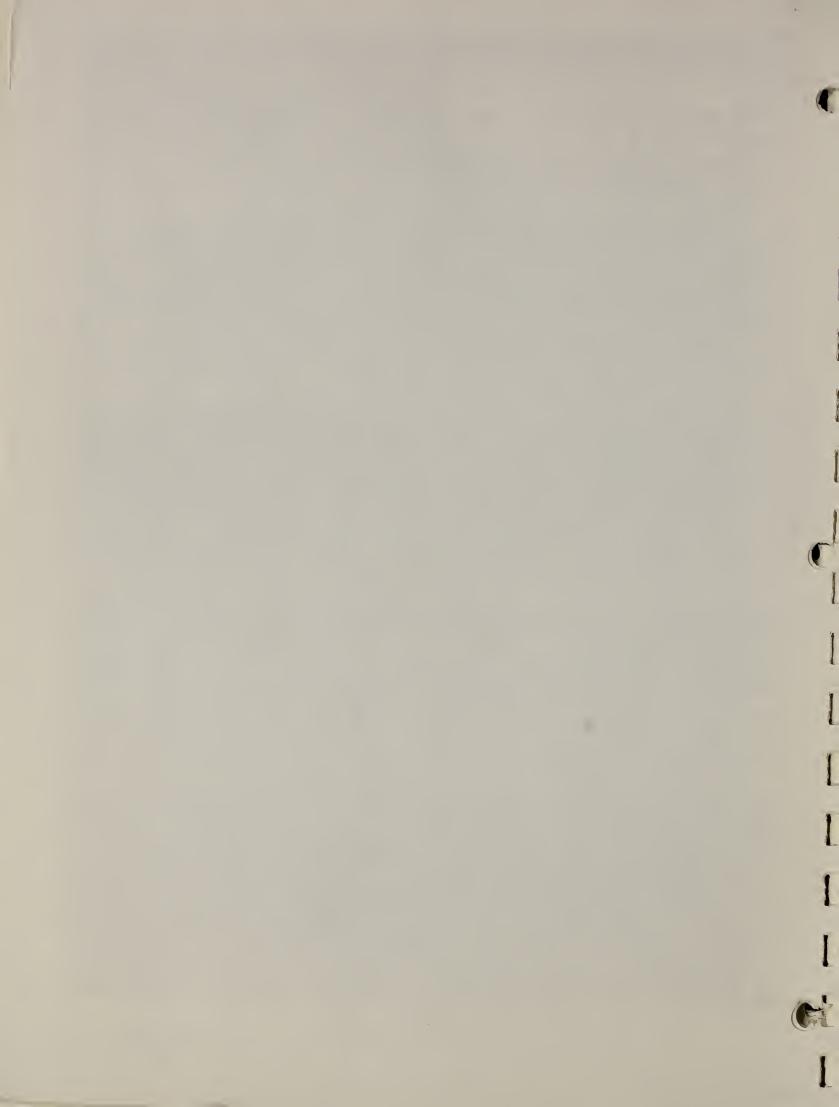


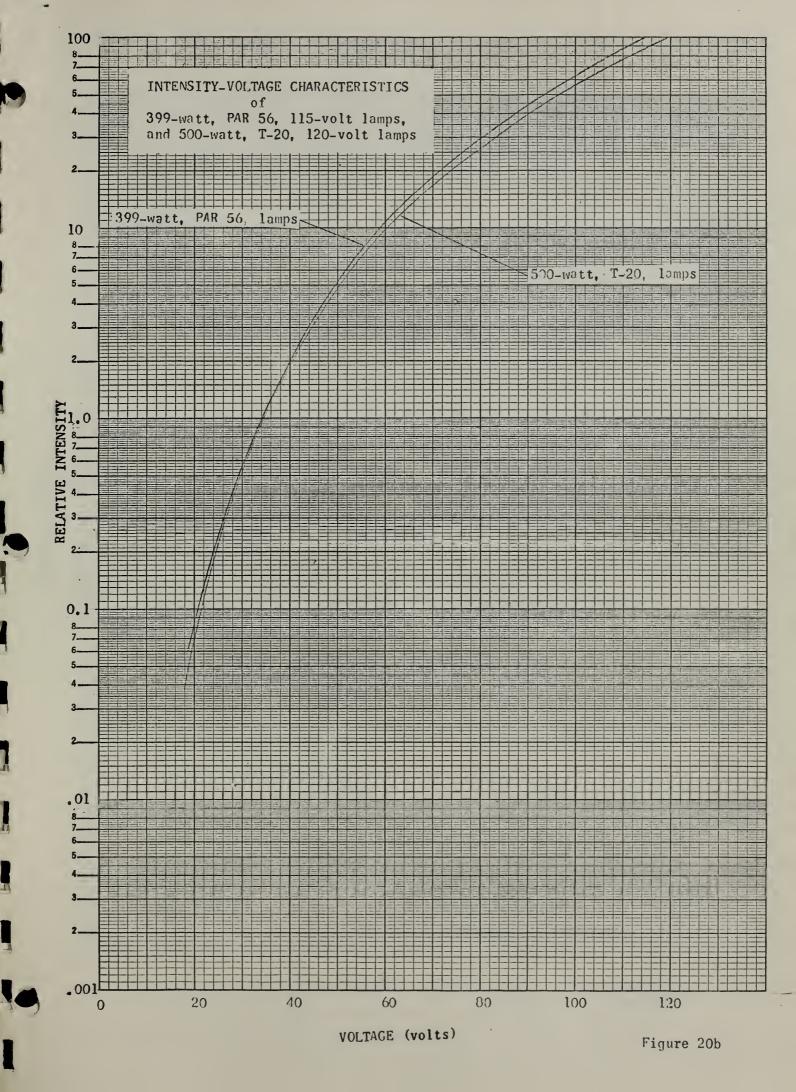


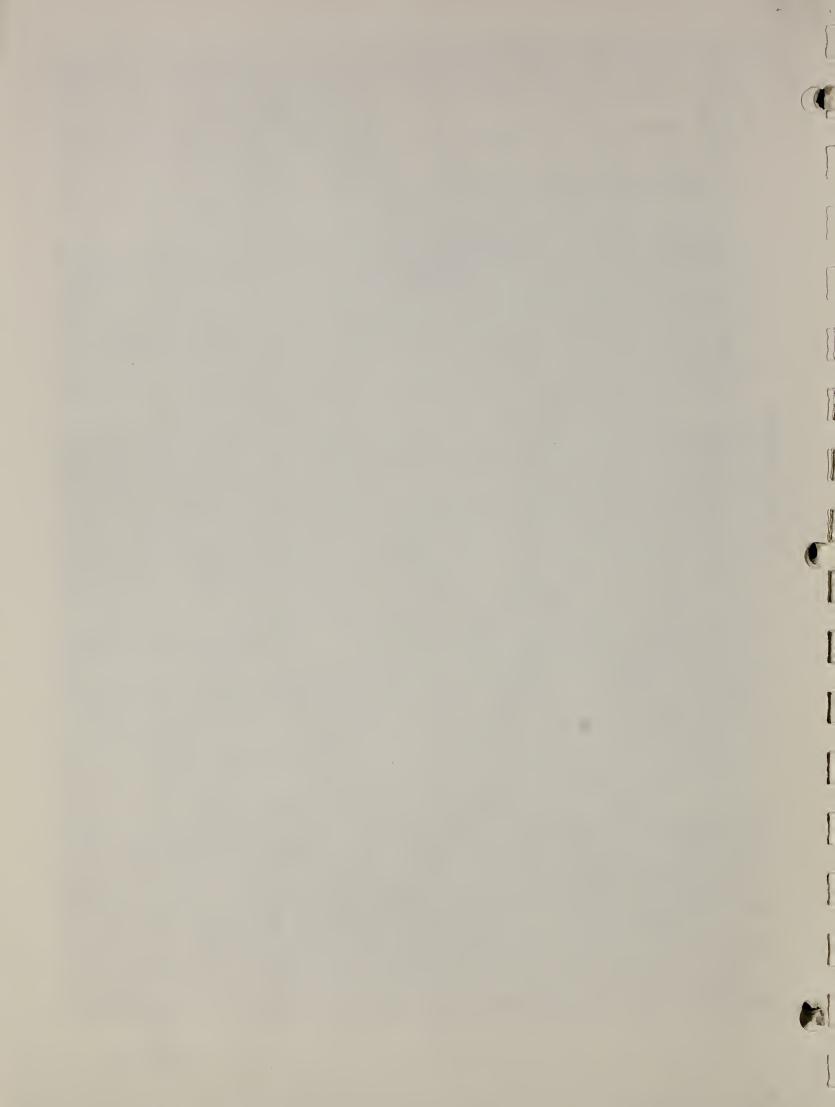


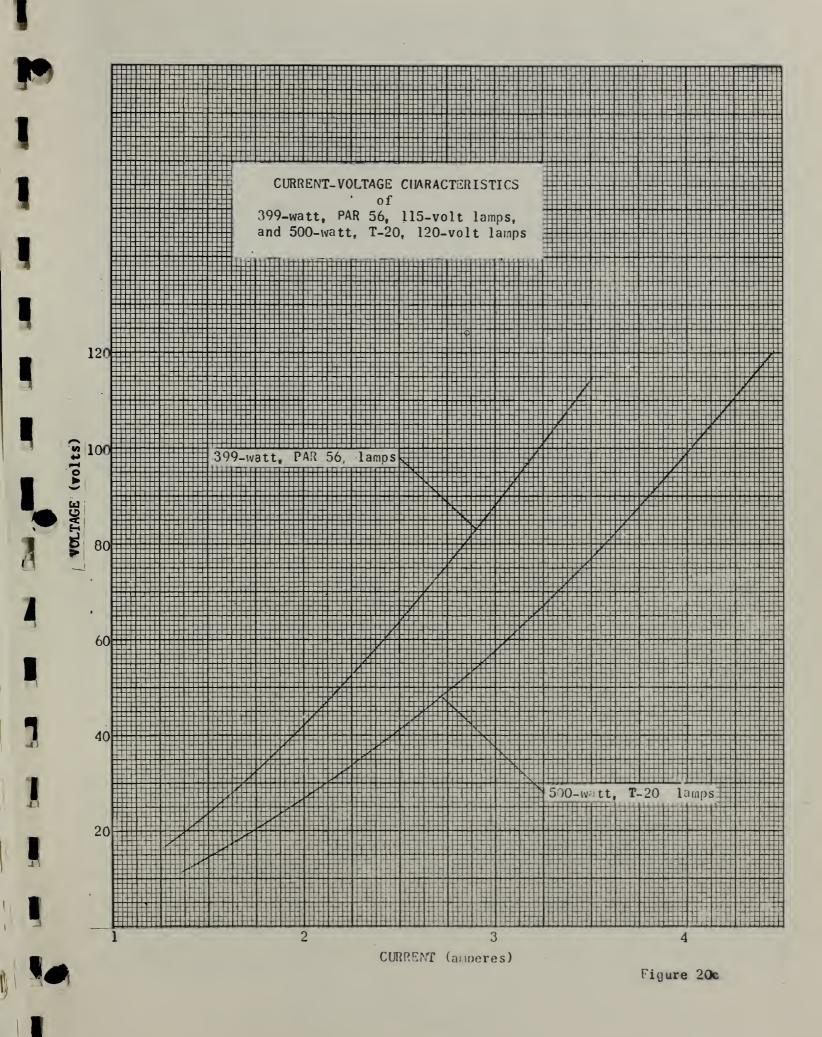


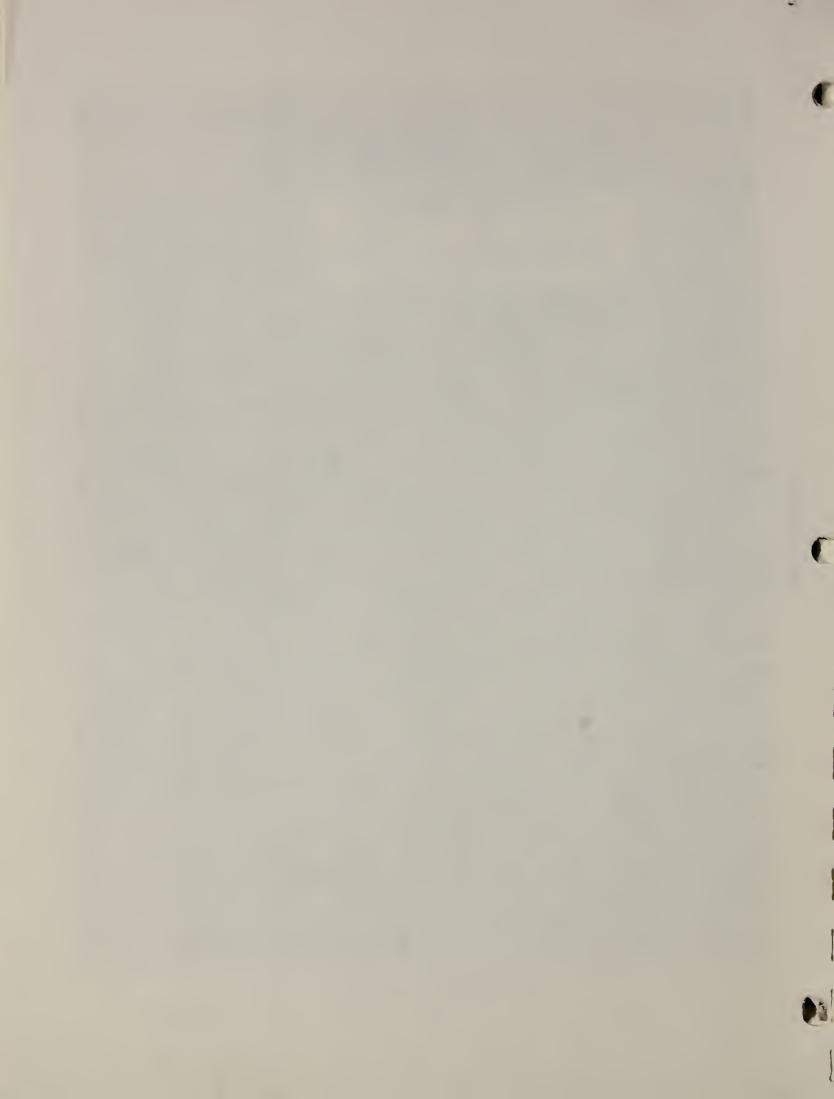


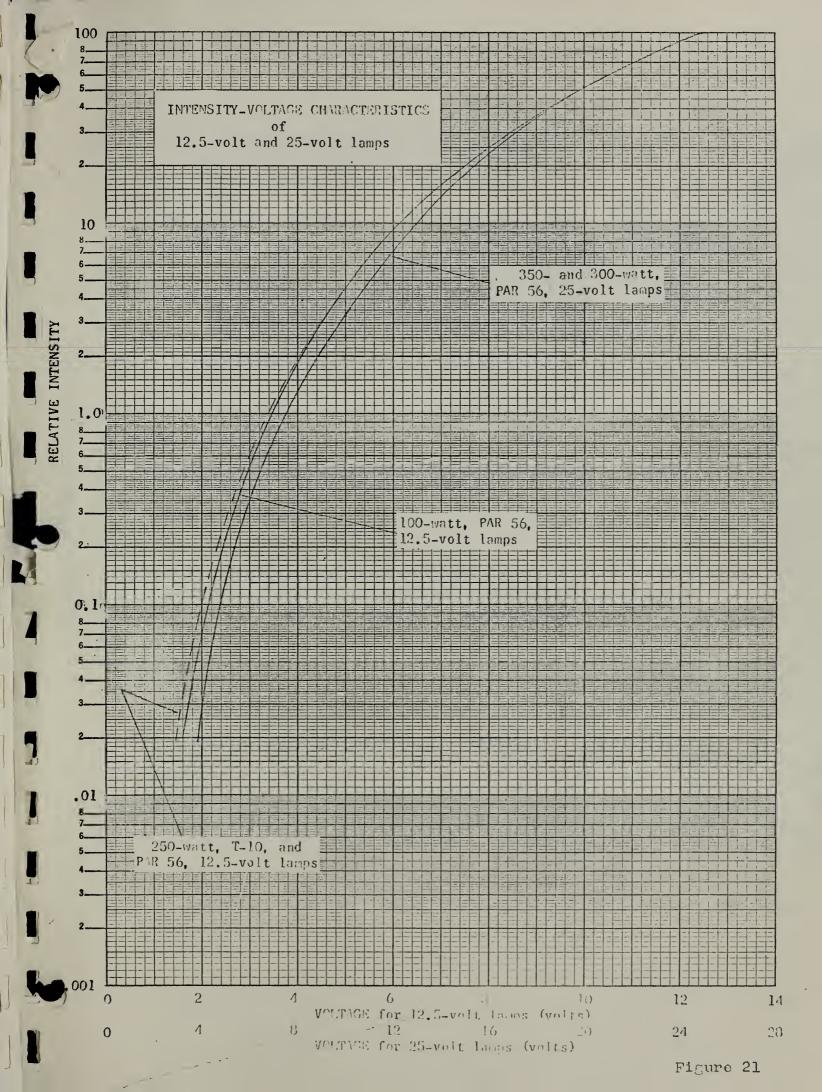


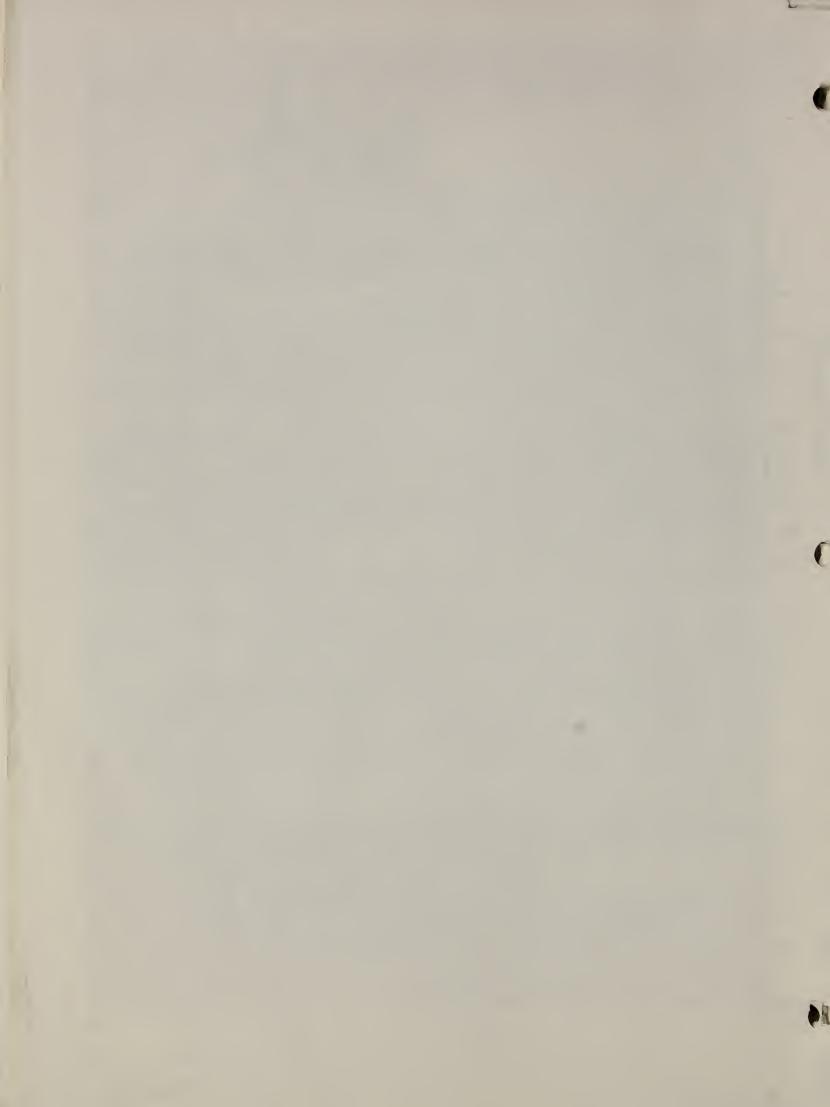


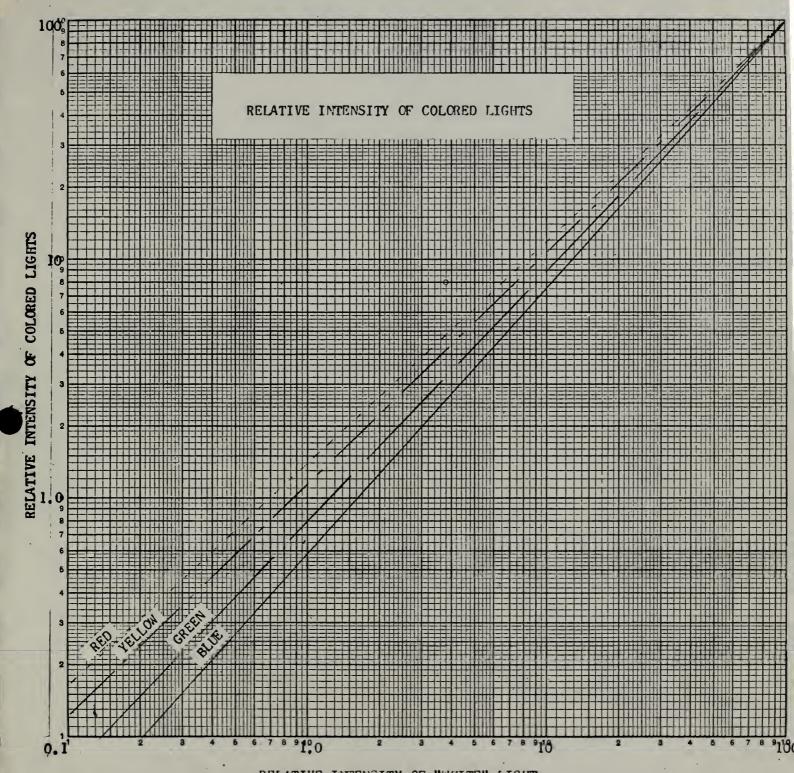












RELATIVE INTENSITY OF "WHITE" LIGHT

Figure 22

